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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

VOICE AND SPEECH.

VOICE or voice sounds are caused by vibration of the inferior or true vocal cords, and are produced by most mammals; while speech, which is peculiar to man, is produced by the same vibrations, with modifications introduced by varying shape and position of the mouth cavity, tongue, and lips.

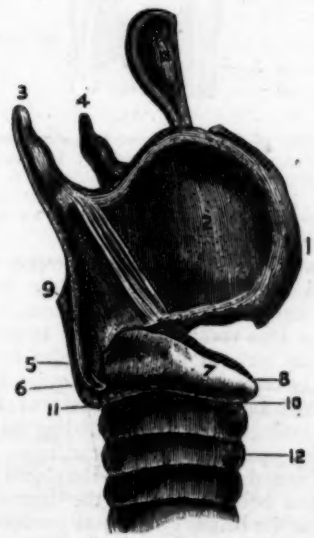


Fig. 83.

Side View of the Larynx. 1. Front angle of thyroid (Adam's apple). 2. Body of thyroid. 3 right, and 4 left, superior cornu of thyroid. 5. Right inferior cornu of thyroid. 6. Point where 5 articulates with cricoid. 7. Cricoid cartilage. 8. Upper border of cricoid in front. 9. Upper border of cricoid behind. 10 and 11. Lower edge of cricoid in front and behind. 12. Trachea. 13. Epiglottis.

The human voice considered as a musical instrument consists of four parts, of which only the larynx will require detailed description; (1) the lungs, the recoil of which during expiration drives the air along (2) the trachea. These two may be compared to the nozzle and body of a bellows. (3) The larynx, which is the essential organ of voice, and contains the vibrating element. (4) The pharynx, mouth, and nasal passages, which form the resonator, supplemented by the chest resonance which occurs below the larynx.

The position of the larynx is indicated externally by the 'Adam's apple,' which consists of the prominent front edge of the thyroid cartilage. Having muscular attachments to the tongue and hyoid bone, it is freely movable during deglutition and speech. The larynx consists of several cartilages which must now be described.

Fig. 84.

Side View of Larynx, the right half of the thyroid having been removed. 1. Left half of thyroid. 2. Left upper cornu of thyroid. 3. Cricoid. 4. Point of attachment of right half of thyroid to cricoid. 5. Upper border of cricoid behind. 6 and 7. Arytenoid cartilages. 6¹. Anterior attachment of vocal chords to thyroid cartilage.

BRITISH MUSEUM

The *thyroid* or shield cartilage (fig. 83) consists of two halves united in front at an angle, but incomplete behind. At their hinder part they project upward and downward in the form of two horns, the upper of which is connected by means of a fibrous band to the hyoid or tongue-bone, and the lower moves over the cricoid with a hinge movement.

The *cricoid* or ring cartilage lies below the thyroid, which it partially supports. It is shaped somewhat like a signet-ring, being narrow in front and having a broad plate-like surface behind. The hinder portion of it is seen in fig. 84.

It is evident that the hinge-like connection between the thyroid and cricoid allows of the interval between the front of the thyroid and cricoid cartilages (which is covered over by membrane) being diminished by muscular action. This is effected by the *crico-thyroid* muscles, which run from the outer surface of the thyroid to the cricoid cartilage. The effect of this hinge-movement is, by increasing the distance between the anterior and posterior surfaces of the larynx, to make tense the vocal chords. It is doubtful whether these muscles are called into action to any important extent during ordinary speech. Paralysis of the internal muscles of the larynx is followed by loss of speech, but paralysis of the crico-thyroid muscles has no such effect.

The *epiglottis* is a pliable leaf-like cartilage attached anteriorly to the inner side of the upper end of the thyroid (fig. 83, 13). During respiration it stands vertically, but in swallowing, when the larynx is drawn under cover of the base of the tongue, it is carried backward and thus closes the upper opening of the larynx.

The *arytenoid* cartilages are so called from the resemblance they bear, when approximated, to the mouth of a pitcher. They are placed at the back of the larynx, lying on the upper border of the cricoid cartilage. Each cartilage is pyramidal in form. Its hinder surface is triangular in shape, and is connected to the corresponding surface of its fellow by a muscle (the *arytenoid muscle*), the action of which is to draw the arytenoid cartilages together. The front surface of each cartilage gives attachment to the hinder end of the false vocal chords and the thyro-arytenoid muscle. The inner surface is narrow and smooth, and lies nearly in contact with its fellow. The base of each cartilage articulates with the cricoid. It presents three angles, of which the external prominent angle has attached to it the posterior and lateral crico-arytenoid muscles, while the anterior angle, also prominent, has attached to it the hinder end of the true vocal chord. The apex of each cartilage is pointed and curved backwards and inwards, and surmounted by a small cartilaginous nodule (cartilage of Santorini or corniculum laryngis). To it is attached the fold of mucous membrane reaching forward to the epiglottis, in which is embedded a small elongated cartilaginous body (cuneiform cartilage or cartilage of Wrisberg).

The epiglottis and the minute cartilages just named consist of yellow elastic cartilage; but the thyroid, cricoid and arytenoid consist of ordinary hyaline cartilage.

The framework of the larynx thus constituted contains numerous muscles, and is lined throughout by mucous membrane, which is reflected over the vocal chords. It is covered with columnar ciliated epithelium below the upper vocal chords; elsewhere the epithelium is of the squamous variety. The larynx is supplied with sensory nerves from the superior laryngeal, and with motor nerves from the inferior laryngeal branch of the vagus nerve. Motor branches are said also to proceed from the superior laryngeal nerve to the crico-thyroid and arytenoid muscles.

The cavity of the larynx extends from behind the epiglottis above to the lower border of the cricoid cartilage below. It is divided into an upper and lower part by the projection inwards of the vocal chords and thyro-arytenoid muscles. Between the two true vocal chords is a chink, the *glottis*, or *rima glottidis*. The two superior or false vocal chords are placed above the glottis, and are formed almost entirely by a folding inwards of the mucous membrane. They form a curved rim reaching on each side of the larynx from front to back, but not approximating so closely to the middle line as the true vocal chords. Between the true and false vocal chords on each side is an oval depression, the *ventricle of the larynx* (or Morgagni's ventricle) leading into a pouch of variable size (the *sacculus laryngis*, fig. 85).

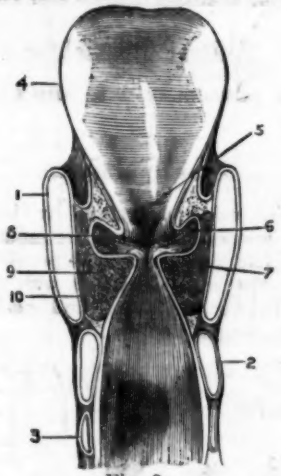


Fig. 85.

Vertical Section of Larynx; front half seen from behind:—1. Thyroid cartilage. 2. Cricoid. 3. First ring of Trachea. 4. Epiglottis. 5. Its median cushion. 6. Upper vocal chords. 7. Lower vocal chords. 8. Sacculus laryngis. 9. Thyro-arytenoid muscle cut across. 10. Lateral crico-arytenoid muscle.

The *rima glottidis* is at the narrowest part of the larynx, and corresponds in level to the lower border of the arytenoid cartilages. It is bounded on each side by the true vocal chords. Its length is rather less than an inch in the adult male; in the female about two or three lines less. In quiet breathing it is a triangular open space, the base of the triangle being backwards, and corresponding to the space between the separated arytenoid cartilages. In the production of sound the margins of the glottis are brought together and become parallel, the degree of tension varying with the height of the note produced.

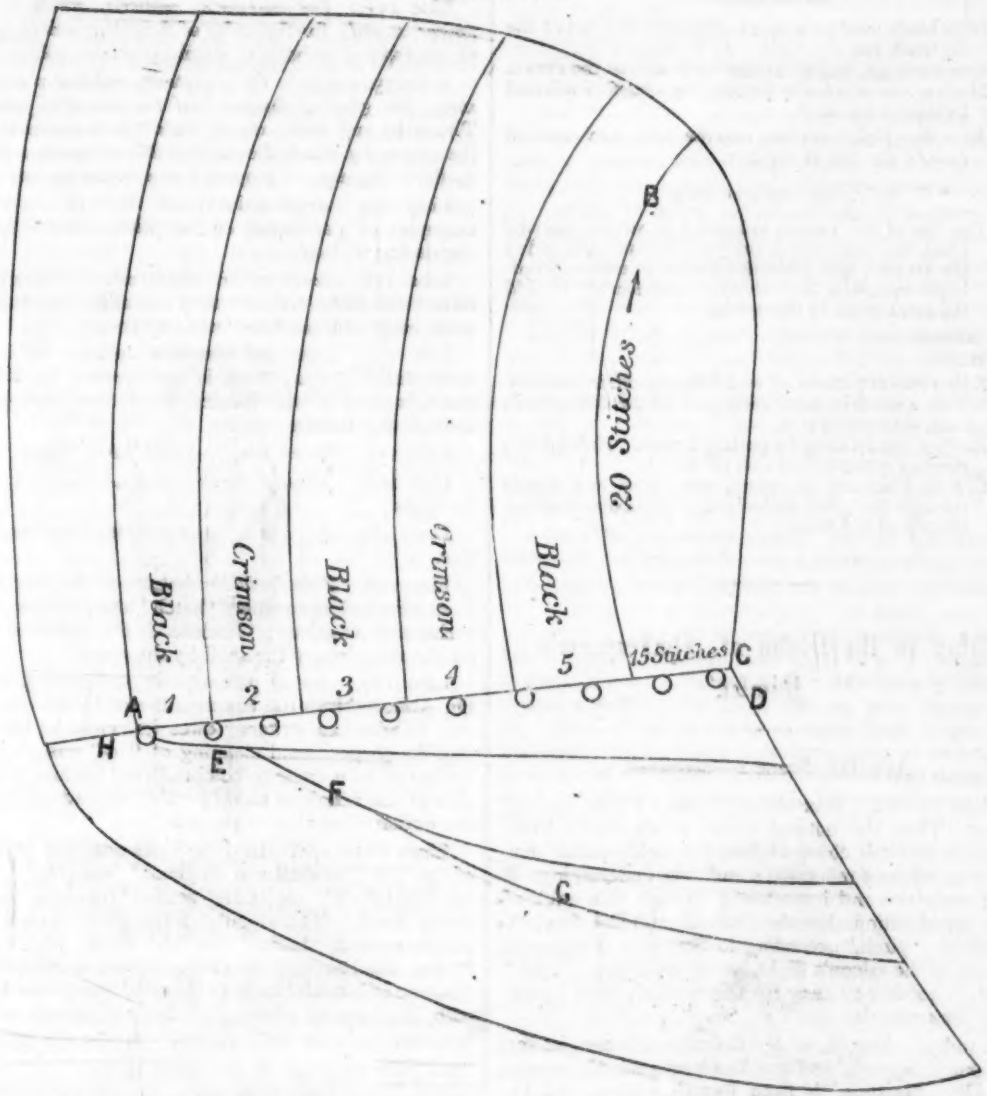
The *inferior* or *true vocal chords* are two strong fibrous bands, each consisting of yellow elastic tissue, attached in front to the inner border of the junction of the two halves of the larynx, and behind to the anterior angle at the base of each arytenoid cartilage. It is not a separable band of elastic tissue, but becomes continuous on its outer border with the thyro-arytenoid muscle.

(To be continued.)

Knitting Maps.

BY MRS. J. D. HARRIS.

BABY'S HOOD.



2 Bone pins. No. 11 Chamber's bell gauge.

1 oz. crimson fingering.

1 oz. black fingering.

The pattern in this hood takes 4 rows.

1st row. Slip 1. Knit 2 together for the rest of the row.

2nd. Slip 1. *Pick up a stitch and knit it. Knit the next stitch, putting the wool twice round the pin. Repeat from*.

3rd. Knit plain.

4th. Purl.

(To keep the right number of stitches you must put 1 in at the beginning or end of the plain row.)

'2 rows of pattern' means these 4 rows twice over.

To make the Front Roll.

Cast on 54 stitches. Knit 1 plain row. Knit 4 rows of pattern.

A. Reverse the knitting by purling 2 rows. Knit 1 more row of pattern.

1. Fasten in the black. (The change of colour must be always on the right side.) Knit 2 rows of pattern, or 8 plain rows; but if economy is an object plain knitting takes less wool.
2. 2 rows of pattern in crimson.
3. 8 plain rows black.
4. 2 patterns crimson.
5. 8 plain rows black.

To make the Crown.

B. With crimson wool knit 20. Knit 2 together 7 times, leaving 20 on the pin. Turn the pin, and knit the pattern for the whole of the crown, knitting in a stitch at each end till all are taken up. 15 will be left.

For the Curtain.

C. With black wool pick up 21 stitches to the end of the 1st black row.
Knit back, picking up 21 the other side of the crown.
Make a row of holes by putting the wool forward, and knitting 2 together.

D. Knit 28. Knit 2 stitches into the 29th. *and mark it.* Knit to the end of the row.

To round off the Curtain.

E. The rest of the curtain is knitted in stripes like the head, but you must leave 3 stitches at each end of the 1st row, and 3 additional ones at each succeeding row, 3, 6, 9, &c., always remembering to add the extra stitch in the centre.

F. Crimson.

G. Black.

H. Knit 1 row of pattern all round the curtain in crimson. Knit a stitch in from each end of the front roll in each succeeding row.
Reverse the knitting by purling 2 rows. Knit 4 more rows of pattern, and cast off loosely.
Sew back the roll all round, add a cord and tassels through the holes at the back, and another to tie on the top of the head.

—o—

Helps to the Study of Shakespeare's 'Hamlet.'

ACT III. Scene 1—*continued.*

Lines 84—88. *thus the native hue . . . the name of action.* Thus the natural colour which marks determination to act is changed into the sickly pallor that betokens anxious reflection; and thus undertakings of great eminence and importance through this habit of over-consideration alter their course and fail for lack of effort. 'pitch,' according to Staunton, means the summit of the falcon's flight, hence eminence. 'pith,' which is another reading for this word, is used figuratively for strength.

Line 89. *Nymph, in thy orisons.*—Maiden, in thy prayers. 'Nymph' is from Latin *nympha*, Gr. *νυμφη*, a bride. 'orisons,' is from French *oraison*, old Fr. *orison*, a prayer, from Latin *oratio*, from *oro*, I pray. Other words similarly derived are *malison*, *benison*.

Line 93. *remembrances,*—mementos, souvenirs.

Line 99. *their perfume lost,*—the sweetness of the words having gone.

Lines 103—149. In this conversation between Hamlet and Ophelia notice that 'honest' is used for chaste, virtuous; and 'honesty' for virtue; 'discourse' and 'commerce' are both used for conversation; 'sometime' means formerly; 'indifferent' is used as an adverb for fairly, ordinarily. 'beck' means call, or rather a sign for a call. 'Monsters,' unnatural beings, literally things or beings to be pointed at, from Latin *monstrare*, to show. In one of the early folios, lines 142 and 143, 'pratlings' is printed for 'paintings' and 'pace' for 'face'; this seems to suit the context better. 'jig,' 'amble' are applied to mincing effeminate modes of walking. 'Nick-name' means misname; a nick-name is properly an additional name, from *an eke name*, by the dropping of the n.

Line 151. *The courtier's, soldier's, scholar's, eye, tongue, sword*; for the order of these two sets of nouns to correspond 'scholar's' should precede 'soldier's.'

Lines 152—153. *The expectancy and rose of the fair state, The glass of fashion, and the mould of form,*—The hope and flower of the state which he made fair, the mirror by which the fashionable dressed, and the model of beauty. Compare Latin *forma*, beauty.

Line 155. *deject,*—down-cast, one of the many examples of participles ending with a dental sound dispensing with *ed*.

Line 156. *honey of his music vows,*—example of mixed metaphor, 'music' used like adjective musical; some early editions have 'musickt vows.'

Line 157. *sovereign reason,*—supreme faculty of understanding; sovereign is spelt *sovran* by Milton, and this accords with its derivation from *superaneus*, through the Italian soprano.

Line 159. *blown youth,*—youth in its bloom.

Line 160. *Blasted with ecstasy,*—blighted with madness.

Lines 163—4. *nor—not*; example of double negative.

Line 166. *I do doubt the hatch and the disclose,*—I am afraid of the result; 'hatch' and 'disclose,' two verbs used as nouns; 'disclose' is the technical term for the chipping of the shell by the chick.

Line 167. *for to prevent,*—in order to prevent. Dr. Abbott thinks the common use of 'for to' in early and Elizabethan writers 'owes its origin to the fact that the prepositional meaning of "to" was gradually weakened as it came to be considered nothing but the sign of the infinitive mood; "for" was added to give the notion of motion or purpose.'

Lines 169—188. In these lines note the omission of 'go' in 'he shall...to England,' 'variable' is used for 'various'; 'something settled' denotes 'rather firmly fixed.' The singular form 'puts' is used after plural subject 'brains,' but the whole phrase 'his brains still beating' may be regarded as the subject. 'fashion of himself' means 'his usual ways.' 'be round with him' means plain. 'in the ear' means 'within hearing.' 'If she find him not'—if she discover not his secret.

Scene 2.

Line 2, *trippingly,*—easily, without halting. *mouth it,*—speak it loudly, roughly.

Line 3. *I had as lief,*—I would as soon. 'had' is subjunctive like 'would have,' 'lief' is an adjective, from A.-S. *leof*, dear.

Line 4. *nor do not,*—double negative.

Line 7. *temperance,*—moderation, from Latin *tempero*, to modify, to moderate, as in our verb to temper.

Line 9. *robustious, periwig-pated fellow,*—noisy violent fellow, having a wig on his head; 'periwig' is a corruption of French *perruque*, Italian *perruca*, Spanish *peluca*, from Latin *pilus*, hair. In Shakespeare's time wigs were only worn by actors.

Line 10. *groundlings,*—those who stood on the ground in the pit of the theatre. There were no seats in the pit, and the charge for admission was one penny.

Line 11. *capable of nothing but inexplicable dumb shows,*—having no taste for anything but stupid pantomime and noise.

Line 13. *Termagant,*—a deity supposed to be worshipped by the Saracens, and often introduced into the old mystery-plays. He was generally full of tyrannical bluster, and was 'the terror and admiration of the multitude.' *it out-herods Herod.*—In some of the mysteries, Herod, King of Judea, was introduced, and was represented as a similar character to Termagant. In 'All's Well that Ends Well,' occurs the expression 'He hath out-villained villany.'

Lines 15—48. In this conversation notice the double negative 'Be not too tame neither,' 'modesty' used for moderation; 'from the purpose,' contrary to the purpose; 'his form and pressure,'—its form and impression; 'come tardy off,' come short of, too feebly rendered; 'censure,' judgment; 'your allowance,' your opinion; 'nor man' means probably 'nor even man;' 'indifferently,' fairly well; 'there be of them,' there are some of them. Dr. Abbott says '*be* is much more common with the plural than with the singular.' 'barren spectators,'—foolish spectators. It was a common practice in the early plays for the clown to extemporise buffoonery for the amusement of the audience. The practice of adding to the dramatist's words is not unknown in our day, the additions made being called 'gag.' 'presently' means immediately: it is often used more loosely now for 'in a short time.'

Line 50. *my conversation coped withal,*—my intercourse with man met with, or encountered. 'cope' is cognate with *cheap, Cheapside, chapman,* and means to have business with.

Line 55. *candied tongue,*—tongue coated with sugar, hypocritical; *absurd,* in this place accented on the first syllable.

Line 56. *crook the pregnant hinges of the knee,*—bend the pliant knee-joints, that is readily kneel and bow. The grammatical subject of 'crook' is 'tongue,' but the real subject is the flatterer, the person who possesses the candied tongue.

Line 57. *Where thrift may follow fawning,*—where profit or advantage may result from the flattery.

Line 64. *blood and judgment,*—passion and reason, feelings and understanding.

Line 65. *a pipe.*—This figure is used again by Hamlet in the conversation with Guildenstern near the close of this scene.

Line 73. *afoot,*—on foot, going on. The phrase 'on foot' is now used in this sense.

Line 74. *with the very comment of thy soul,*—with the utmost earnestness.

Line 75. *occulted,*—secret, concealed: only time this word occurs.

Line 76. *Unkennel itself,*—reveal itself, come out of hiding place, 'kennel' is from Low Latin *canile,* a place for dogs.

Line 79. *Vulcan's stithy,*—The smithy of Vulcan, the god of fire: 'stithy' is the forge, or the place where the *stith* or anvil stands.

Line 82. *In censure of his seeming,*—in forming an opinion of his appearance.

Line 84. *pay the theft,*—pay for what is stolen. 'Theft' usually means the act of stealing, here it means the thing stolen.

Line 85. *I must be idle,*—I must put on a silly frivolous manner.

Line 87. *How fares,*—How is; 'fares' from A.-S. *faran,* to go. In his answer Hamlet appears to understand it 'feeds,'—an intentional mistake.

Line 88. *Of the chameleon's dish,*—on air. That the chameleon lived on air was a popular error. Chameleon is derived from Greek χαμαι, on the ground, λεων, lion: hence the name means the ground-lion.

Line 92. *You played once i' the University.* It was from early times till the last century the practice to enact Latin plays in the Universities of Oxford and Cambridge on special occasions. The custom is still kept up at Westminster School.

Line 97. *Julius Cæsar,*—Malone thinks an English play on this subject existed before Shakespeare's which was probably produced in 1601. A Latin one was performed at Christchurch College, Oxford, in 1682.

Line 98. *i' the Capitol,*—This is a mistake which appears also in Shakespeare's play. Cæsar was killed in the Curia Pompeii, the council-house of Pompey.

Line 101. *stay upon,*—await.

Line 108. *jig-maker,*—A jig meant a humorous ballad, or dialogue, as well as a lively dance.

Line 110. *within's two hours,*—within this or these two hours.

Line 112. *for I'll wear a suit of sables,*—Warburton has suggested that for is used for 'fore. Staunton supports the same view, and thinks the words may be accompanied with the act of flinging away his mourning cloak. The Clarendon Press editors favour the idea that 'sables' here does not apply to mourning garb, but to fur trimmings, and further that there is a kind of équivoque or play on the word 'sables' intended.

Line 115. *by'r lady,*—by our lady, a common form of expression, like 'Marry' for Mary in line 120 of this scene.

Line 117. *he shall suffer not thinking on,*—he shall be forgotten.

the hobby-horse,—in the old Mayday games and Morris dances one of the characters was made up like a horse, the horse's legs being represented by the legs of the man. The Puritans opposed these games, and put them down; hence the reference to the epitaph.

Line 119. *miching mallecho,*—sneaking, secret mischief. *micher* is used in the First Part of Henry IV. for truant, and an old word *miche* meant to hide out of the way secretly like a truant. *Malhecho,* is Spanish for an evil deed; Lat. *male,* evil, *factum,* done, *f* becoming *h.*

Line 121. *Belike,*—perhaps, probably. *argument,*—plot.

Line 123. *keep counsel,*—keep a matter secret.

Line 127. *posy of a ring,*—motto on a ring, usually a short verse. 'posy' from *poesy.*

Line 130. *Phœbus' cart,*—the chariot of Phœbus, that is the sun.

Line 131. *Neptune's salt wash.*—the sea. *Tellus' o'er bed ground,* the round world.

Line 132. *sheen*,—light, noun from *shine*.

Line 133. *Hymen*—the god of marriage.

Line 134. *commutual*,—stronger form of mutual, prefix *com* having intensive force; compare *commingle*, *corrival*.

Line 138. *Woe is me*,—Woe is for me; 'me' is dative.

Line 140. *I distrust you*,—I am distrustful for you.

Lines 142—143. *For women's fear and love holds quantity, In neither aught, or in extremity.*

For the fear a woman feels is exactly proportionate to her love, either both are lacking, or both are in excess. 'holds' is an example of what is very common in Shakespeare, the use of the inflection 's' with two singular nouns as subject. It is not necessary to regard this as a grammatical error, for in Early English there were three forms of plural endings for verbs, es, en, th, the first prevailing in the North of England, the second in the Midlands, and the last in the South. The frequency with which Shakespeare uses the first form is thought by Dr. Abbott to indicate a general predilection for the Northern inflection.

Line 145. *stiz'd*,—nowhere else used by Shakespeare.

Line 146. *littlest*,—for least, smallest, survives in some provincial dialects.

Line 149. *operant*,—active; *leave*, leave off, cease.

Lines 157, 8. *The instances that second marriage move Are base respects of thrift*,—The motives that prompt a second marriage are low considerations of profit.

Line 162. *break*,—the rhyme requires this to be pronounced breek. This pronunciation still prevails in the northern counties.

Line 164. *validity*,—strength.

Line 166. *fall unshaken*,—falls without being shaken. The use of 'fruit' with a plural meaning accounts for the change of construction from 'sticks' to 'fall.'

Line 167. *Most necessary 'tis that we forget To pay ourselves what to ourselves is debt*,—It is unavoidable that we should neglect to pay debts which we owe only to ourselves, which none but ourselves can claim.

Line 171. *enactures*,—resolutions, what they have enacted or determined. Nowhere else used. *destroy*,—another instance of concord influenced by the nearer noun.

Line 178. *Whether*,—a monosyllable *whe'r*. *or else*, a reduplication like *an if*.

Lines 182—190. Notice the uncommon inversion *not needs*, for 'does not need;' *seasons*, for 'ripens' or brings to maturity, develops; *begun*, for 'began;' *contrary*, with accent on second syllable; *die*, third person imperative for 'let die.'

Line 194. *an anchor's cheer in prison be my scope*,—Let all I aim at or look for be the fare of an anchorite or hermit; anchorite, in old English *ancor*, is from ἀναχωρητής, one who separates himself from the world. It was applied to man or woman.

Line 195. *opposite*,—opponent or hostile influence; *blanks*,—blanches, makes pale.

Line 208. *Is there no offence in't?*—The King appears to have given slight attention, if any, to the dumb-show.

Line 212. *Tropically*,—figuratively, by a metaphor. trope is a figure of speech in which a word is *turned* from one meaning to another, from Greek τροπος, a turning, τρεπω, I turn.

Line 216. *free*,—innocent, as in Act II. Scene 2, 'appal the free.'

Let the galled jade wince, our withers are unwrung. Let the tired horse, fretted by his collar, smart and flinch, our neck and shoulders are not hurt. We who are innocent are not annoyed by the play, let the guilty suffer. 'jade' is used for a worthless or worn-out nag; 'withers' are the parts between the shoulders of a horse.

Line 219. *chorus*,—a person who explained the action of the play in Greek tragedies. Shakespeare adopted the plan in 'A Winter's Tale,' 'Henry V.'

(To be continued.)

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Quarterly Arithmetical Tests.

STANDARD I.—FIRST QUARTER.

1. 59
3
604
5
70

2. 487
413

3. 926
502

4. 5×2;
8×3;
4×4.

SECOND QUARTER.

1. 921
85
7
460
35

2. 319
84

3. 650
107

4. 12×3;
7×4;
6×5.

THIRD QUARTER.

1. 8
149
6
75
893

2. 526
478

3. 234
39

4. 11×4;
3×5;
10×6.

STANDARD II.—FIRST QUARTER.

1. 6
58
904
3,072
48,691

2. From 53,018 take 6,709.

3. Multiply 47,809 by 35.

4. 7×9; 12×11; 8×12.

SECOND QUARTER.

1. Take 9,999 from 30,001.
2. $63,795 \times 120$.
3. $27,156 \div 4$.
4. 39d.; 57d.; 74d.

THIRD QUARTER.

1. From 40,608 take 30,809.
2. $59,067 \times 907$.
5. Divide ten thousand by eleven.
4. 95d.; 117d.; 132d.

STANDARD III.—FIRST QUARTER.

1. Divide 20,815 by 23.

2. What number multiplied by forty-seven gives a product of two hundred and eighty-five thousand seven hundred and sixty?

3. Divide five hundred thousand by six hundred and fifty-eight.

4. How many years are there in nine hundred and forty-six thousand eight hundred and ten days, reckoning 365 days in a year.

SECOND QUARTER.

1. A book contains 74 leaves and thirty-four thousand seven hundred and eighty words. How many words on an average are there to a *page*.

2. Add together three hundred and six pounds twelve shillings and five pence farthing, twenty-nine pounds nineteen shillings and three pence three-farthings, seven pounds fourteen shillings and eight pence, nine hundred and thirty pounds seventeen shillings and six pence halfpenny, and eighteen pounds thirteen shillings and nine pence three-farthings.

3. From £724 16s. 10¼d. take £639 17s. 9½d.

4. A person had in his pockets two sovereigns, three half-sovereigns, five crowns, seven sixpences, and fourteen pennies. How much less than five pounds had he?

THIRD QUARTER.

1. What is the difference between two thousand and seventy-three pounds eleven shillings and eleven pence halfpenny, and three thousand and ten pounds ten shillings and ten pence three-farthings?

2. $(6{,}764 \times 75) \div 89$.

3. £4,369 12s. 11¾d. + £682 17s. 9½d. + £57 18s. 10¾d. + £5 19s. 6¼d. + £5,608 15s. 8½d. + £490 14s. 7⅞d.

4. How long will it take a person to save thirteen guineas, if he save seven shillings weekly?

STANDARD IV.—FIRST QUARTER.

1. £65 18s. 9¼d. × 43.

2. Divide three thousand six hundred and thirty-nine pounds five shillings and eight pence halfpenny by seven.

3. If a soldier's uniform cost £2 15s. 10½d., find the cost of the uniform for a regiment of 796 men.

4. If a row of 38 houses cost £7,975 11s. 4d., what is the value of each house?

SECOND QUARTER.

1. Reduce 3½ million ounces to tons, &c.

2. In three years a farmer paid £574 8s. 6d. as the rent of 69 acres; find the annual rent per acre.

3. How many square yards are equal to 46a. 3r. 28p.?

4. How many books at 3s. 9d. each could you get for ten guineas?

THIRD QUARTER.

1. Reduce one million sixty thousand and forty inches to miles, yards, feet, and inches.

2. A man bought a chest of oranges containing 1,075 for £1 7s. 6d. How much did he gain by selling them at a halfpenny each?

3. If you can count 75 in a minute, in what time could you count one and a half millions, counting day and night?

4. How much money must be given with 90 lbs. of beer at 8½d. per lb. to pay for 11 cheeses, each 1½ stone, at 9d. per lb.?

STANDARD V.—FIRST QUARTER.

1. Find the value (by practice) of a chest of tea, weighing 5 cwt. 2 qrs. 19 lbs., at 2s. 10½d. per lb.

2. A farmer sold 297 oxen at £26 18s. 3d. each, and bought 1,503 sheep at £2 13s. 8d. each. How much had he after both transactions?

3. What is the value of 5 tons 17 cwt. 2 qrs. 15½ lbs. at 18 guineas per cwt.?

4. Find the value of 15 pieces of cloth, each measuring 29 yds. 2 qrs. 3 nls. at 11s. 4d. per yard.

SECOND QUARTER.

1. Make out a bill for:—

150 eggs at 1s. 6d. a score;
135 oranges at 7d. a dozen;
52 lemons at 9d. a dozen;
34 cabbages at 1s. 9d. a dozen;
27 cauliflowers at 2s. 3d. a dozen.

2. If 240 sacks of corn can be ground in 32 hours, how long will it take to grind 105 sacks?

3. How much must be given for 17 barrels 29 gals. 1 qt. of beer at 51s. per barrel?

4. If 36 men can do a piece of work in 15 days, how long will it take 54 men to do three times as much?

THIRD QUARTER.

1. From the sum of $\frac{3}{10}$ and $\frac{2}{5}$ take the sum of $\frac{1}{3}$ and $\frac{1}{10}$.

2. A peal of six bells ring at intervals of 2, 3, 5, 8, 12, and 18 seconds. At what intervals will they all toll together?

3. What is the difference between the greatest and the least of the fractions:—$\frac{3}{7}$, $\frac{5}{8}$, $\frac{4}{9}$, and $\frac{7}{10}$?

4. If the carriage of 1 cwt. 3 qrs. 7 lbs. for 84 miles be 7s. 6d., what will it cost to have 2 tons 10 cwt. 3 qrs. carried the same distance?

STANDARD VI.—FIRST QUARTER.

1. Divide the sum of $\frac{2}{5}$ and $(\frac{2}{3} - \frac{1}{4})$ by the sum of $\frac{1}{4}$, $\frac{5}{9}$, and $\frac{3}{14}$.

2. Simplify:— $\cfrac{1}{2 + \cfrac{1}{3 + \frac{1}{4}}}$.

3. A person sold ·35 of an estate to one person and $\frac{4}{13}$ of the remainder to another. How much of the estate had he left?

4. Express the sum of ·5, ·18, and ·027 as a recurring decimal.

SECOND QUARTER.

1. 36 masons can build a wall in 49 days, but after working 16 days 14 of them strike; in how many days after the strike will the wall be completed?

2. From $\frac{19}{35}$ of a ton a grocer sold $6\frac{3}{7}$ of 2 qrs.; how many lbs. had he left?

3. Reduce 5·5 of 2d. + 3·75s. + ·1625 of £1 to the decimal of 9s. 6d.

4. A train can travel ·54 of a mile in ·72 of a minute; how far can it go in half an hour?

THIRD QUARTER.

1. What is the simple interest on £476 5s. for 2 years 146 days at $3\frac{1}{3}$ per cent.?

2. An estate was sold for £17,926 and the owner received £17,253 15s. 6d. as the net proceeds; what was the rate of commission in the pound?

3. How long will £350 take to produce £26 5s. at 3 per cent.?

4. If 1 qr. 7 lbs. of green tea be mixed with 3 cwt. 7 lbs. of black tea, what decimal fraction of the mixture is green tea?

STANDARD VII.—FIRST QUARTER.

1. If a tradesman with a capital of £300 gain £70 in 2 months, what sum will he gain with a capital of £500 in 9 months?

2. What sum will amount to £325 6s. 6d. in $2\frac{1}{2}$ years at $2\frac{1}{4}$ per cent.?

3. If 35 men can do a piece of work in 12 days of 12 hours, how many hours a day must 54 women work to do it in 21 days, supposing 9 women can do as much as 5 men?

4. At what rate per cent. will £257 10s. gain £46 7s. in $4\frac{1}{2}$ years?

SECOND QUARTER.

1. What is the present value of a bill of £500 due in 9 months at $3\frac{3}{4}$ per cent.?

2. 37 cows being offered for sale, 13 of them were sold at 15 guineas each, and the remainder for £452; what was the average price per cow?

3. The discount on a bill due in 4 months at 4 per cent. is £3 5s.; find the amount of the bill.

4. If a man walk 528 yards in 5 minutes, another 540 yards, and a third 582 yards, what is the average number of miles per hour?

THIRD QUARTER.

1. In a regiment of 950 men 14 per cent. were killed and 32 per cent. were wounded. Give the numbers of killed, wounded, and unhurt?

2. What percentage of coffee and chicory is there in a mixture of 7 cwt. 2 qrs., of which 4 cwt. 2 qrs. is chicory?

3. Find the amount of £450 for 2 years at 3 per cent., compound interest.

4. What sum must be invested in the $3\frac{1}{2}$ per cents. at $94\frac{3}{8}$ to obtain a half-yearly dividend of £50, brokerage being $\frac{1}{8}$ per cent.?

ANSWERS.

STANDARD I.

	First.	Second.	Third.
1.	741.	1,508.	1,131.
2.	74.	235.	48.
3.	424.	543.	193.
4.	10; 24; 16.	36; 28; 30.	44; 15; 60.

STANDARD II.

	First.	Second.
1.	52,731.	20,002.
2.	46,309.	7,655,400.
3.	1,673,315.	6,780.
4.	63; 132; 96.	3s. 3d.; 4s. 9d.; 6s. 2d.

	Third.
1.	9,799.
2.	53,573,769.
3.	909 + 1.
4.	7s. 11d.; 9s. 9d.; 11s.

STANDARD III.

	First.	Second.	Third.
1.	905.	235 words.	£936 18s. 11½d.
2.	6,080.	£1,293 17s. 9½d.	5,700.
3.	759 + 578.	£84 19s. 0¾d.	£11,215 19s. 6½d.
4.	2,594 years.	4d.	39 weeks.

STANDARD IV.—FIRST.

1.	£2,835 7s. 1¾d.	3.	£2,223 16s. 6d.
2.	£519 17s. 11½d.	4.	£209 17s. 8d.

SECOND.

1.	97 tons 13 cwt. 14 lbs.	3.	227,117 sq. yds.
2.	£2 15s. 6d.	4.	56 books.

THIRD.

1. 16 miles 1,285 yds. 1 ft. 8 in.
2. 17s. 3½d.
3. 13 days 21 hrs. 20 min.
4. £5 9s. 6d.

STANDARD V.—FIRST.

1.	£91 5s. 7½d.	3.	£2,223 7s. 3¾d.
2.	£3,959 19s. 3d.	4.	£252 6s. 10½d.

SECOND.

1. 11s. 3d. + 6s. 6¾d. + 3s. 3d. + 4s. 11½d. + 5s. 0¾d. = £1 11s. 1d.
2. 14 hours.
3. £45 8s. 5¼d.
4. 30 days.

THIRD.

1.	½.	3.	$\frac{12}{25}$.
2.	Six minutes.	4.	£10 10s.

STANDARD VI.

	First.	Second.
1.	$\frac{1}{84}$.	54 days.
2.	$\frac{1}{15}$.	856 lbs.
3.	$\frac{9}{20}$ or ·45.	·83.
4.	·764400.	22½ miles.

THIRD.

1.	£38 2s.	3.	2½ years.
2.	9d.	4.	·0925.

STANDARD VII.

	First.	Second.
1.	£525.	£486 6s. $5\frac{127}{144}$d.
2.	£308.	£17 15s.
3.	8 hours.	£247.
4.	4 per cent.	$3\frac{3}{4}$ miles.

	Third.
1.	133 killed, 244 wounded, and 573 unhurt.
2.	40 per cent. of coffee and 60 per cent. of chicory.
3.	£477 8s. 1½d.
4.	£2,700.

NOVEMBER.

Andante.

1st TREBLE.
2nd TREBLE.
BASS.

1. The leaves are fad - ing and fall - ing, The winds are rough and
2. And when the win - ter is o - ver, The boughs will get new
3. The clouds are gath' - ring and whirl - ing, The brooks are dry and

KEY E♭. *Andante.*

1st TREBLE. | :m | m :— :m | m :f :s | l :— :— | s :— :m | r :— :m | f :m :r |
2nd TREBLE. | :d | d :— :d | d :r :m | f :— :— | m :— :d | t, :— :d | r :d :t, |
BASS. | :d | d :— :d | d :d :d | d :— :— | d :— :d | s, :— :s, | s, :— :s, |

strong .....; The birds have ceased their call - ing, In sweet and tune - ful song. .....
leaves .....; The quail will seek the clo - ver, The swal - low seek the leaves. .....
dumb .....; The wind the leaves is twirl - ing, But yet the spring will come. .....

B♭.t.

m :— :—	m :— :m	r s, :— :d	d :r :m	f :— :—	r :— :d	t, :— :t,	t, :d :r	d :— :—	d :—
d :— :—	d :— :d	t, m, :— :m,	m, :f, :s,	l, :— :—	l, :— :l,	s, :— :s,	f, :— :f,	m, :— :—	m, :—
d :— :—	d :— :d	s, d :— :d	d :— :d	f, :— :—	f, :— :f,	s, :— :s,	s, :— :s,	d, :— :—	d, :—

Though day by day as it clo - ses, Doth dark - er and dark - er grow, The
The ro - bin wears on his bo - som, A coat that is bright and new, And
There must be rough and cold wea - ther, And tem - pests rain and snow, Not

f. E♭. f

d s	r' :— :d'	t :d' :r'	d' :— :—	s :— :s	s :f :m	f :— :l	s :— :—	s
d s	f :— :m	r :m :f	m :— :—	m :— :d	d :d :d	d :— :d	d :— :—	t, :— :—
d s,	s, :— :s,	s, :s, :s,	d :— :—	d :— :m	m :f :s	l :— :f	m :— :—	r :— :—

roots of bright red ro - ses, Will live down un-der the snow. .....
love - li - est way - side blos - som, Will shine and glis-ten with dew. .....
all good things to - geth - er, Are with us here be - low. .....

s :l :s	d' :— :d	l :— :—	s :— :m	r :— :m	f :m :r	d :— :—	d :—
d :— :d	d :— :d	d :— :—	d :— :d	t, :— :d	r :d :t,	d :— :—	d :—
m :f :m	m :— :m	f :— :—	m :— :d	s, :— :s,	s, :s, :s,	d :— :—	d :—

Christopher Columbus, by Lamartine.

TRANSLATED BY A. M. BOWER, F.R.G.S.,

Late Master in University College School, London.

CHRISTOPHE COLOMB.	CHRISTOPHER COLUMBUS.
PREMIÈRE PARTIE.	FIRST PART.

CHAPTER XV.

Cette lettre, lue	This letter, read
avec prévention et incrédulité	in a spirit of prejudice and distrust
par le confesseur de la reine,	by the queen's (father) confessor,
n'ouvrit à Colomb	opened up to Columbus
qu'une longue perspective d'attente,	nothing but a lengthy prospect of waiting,
de refus d'audience	of refused audiences
et de découragement.	and discouragements.
Les hommes n'ont d'oreilles	Men have no ears
pour les pensées hardies	for schemes of daring
que dans la solitude	except when alone
et dans le loisir.	and at leisure.
Dans le tumulte des affaires	In the whirl of business
et des cours, ils n'ont	and of courts they have
ni bienveillance ni temps.	neither goodwill nor time.
Colomb fut repoussé	Columbus was repulsed
de toutes les portes,	from every door,
'parce qu'il était étranger,'	'Because he was a foreigner,'
dit l'historien Oviedo,	said Oviedo the historian,
contemporain de ce grand homme,	a contemporary of this great man,
'parce qu'il était	'Because he was
pauvrement vêtu,	indifferently clad,
et parce qu'il n'apportait	because he did not carry with him
aux courtisans et aux ministres	to fine ladies and ministers of state
d'autre recommendation que	other recommendation than
la lettre d'un moine	the letter of a monk
franciscain solitaire,	a Franciscan recluse,
depuis longtemps oublié des cours.'	long since forgotten at court.'
Le roi et la reine	The king and queen
n'entendirent même pas	did not even hear
parler de lui ;	his name mentioned ;
le confesseur d'Isabelle,	the (father) confessor of Isabella,
par indifférence ou par dédain,	whether through indifference or disdain,
trompa complètement l'espoir	entirely disappointed the hope
que Juan Perès avait mis en lui.	that Juan Peres had placed in him.
Colomb, obstiné	Columbus, inflexible of purpose
comme la certitude	as the certainty
qui attend l'heure,	which bides its time,
ne s'éloigna pas de Cordoue	did not retire from Cordova
afin d'épier de plus près	in order to watch on the spot for
un moment plus propice.	a more propitious moment.
Après avoir épuisé dans l'attente	After having exhausted, while waiting,
la bourse modique de son ami,	the slender means of his friend
le prieur de la Rabida,	the prior of La Rabida,
il gagna misérablement sa vie	he eked out a miserable existence
dans son petit trafic	in a petty traffic
de globes et de cartes,	in globes and charts,
jouant ainsi avec les images	thus playing with the images
d'un monde qu'il devait conquérir.	of the world he was to conquer.
Sa vie rude et patiente,	His life rough and enduring,
pendant ces nombreuses années,	during these numbers of years,
ne laisse entrevoir	permits only an occasional glimpse
au fond de son obscurité	in the depth of its obscurity
que la misère, le travail	of distress and toil
et les espérances trompées.	and baffled hopes.
Jeune et tendre de cœur,	Young and affectionate in heart,
il aima cependant	he loved however
et il fut aimé	and was beloved
pendant ces années d'épreuves ;	during these years of trial ;
car un second fils, Fernando,	for a second son, Fernando,
lui naquit vers ce temps,	was born to him, about that time,
d'un amour mystérieux,	from a clandestine attachment
que le mariage ne consacra jamais,	which the (rites of) marriage never consecrated,
et dont il rappelle la mémoire	the memory and remorse of which he recalls
et le remords en paroles touchantes	in touching words
dans son testament.	in his will.
Il éleva ce fils	He brought up this son
avec autant de tendresse	with as much tenderness
que son autre fils Diego.	as his other son, Diego.

CHAPTER XVI.

Sa grâce et sa dignité extérieure	The courteous dignity of his manner
transpiraient cependant	was seen however
à travers son humble profession.	from under his humble profession.
Les personnages distingués	Eminent persons
de qui son commence scientifique	with whom his scientific trade
le rapprochait quelquefois	brought him occasionally into contact,
recevaient de sa personne	received from his presence
et de ses entretiens	and conversation
cette impression d'étonnement	that impression of wonder
et d'attraction.	and attraction (which is)
prophétie électrique d'une grande destinée	the electrical prophecy of a noble destiny
dans une médiocre condition.	in a condition of mediocrity.
Ce trafic et ces entretiens	This trade and these conversations
lui firent insensiblement	insensibly brought him
des amis à Cordoue,	friends at Cordova
et jusque dans la cour.	and even at court.
Parmi ces amis,	Among these friends,
dont l'historie a conservé	whose names history has preserved
les noms pour les associer	to associate them
à la reconnaissance du monde futur,	in the gratitude of posterity,
on cite Alonzo de Quintanilla,	one cites Alonzo de Quintanilla,
contrôleur des finances d'Isabelle :	Isabella's chancellor of the exchequer :
Geraldini, précepteur	Geraldini, tutor
des jeunes princes ses fils,	to the young princes her sons,
et Antonio Geraldini,	and Antonio Geraldini,
nonce du pape à la cour de Ferdinand :	papal legate at the court of Ferdinand :
enfin Mendoza	lastly Mendoza
Archevêque de Tolède et cardinal,	Archbishop of Toledo and a Cardinal,
homme d'un tel crédit	a man of such consequence
qu'il était appelé	that he was called
le troisième roi d'Espagne.	the third King of Spain.

CHAPTER XVII.

L'archevêque de Tolède,	The Archbishop of Toledo,
d'abord effrayé	at first dismayed
de ces nouveautés géographiques	by these geographical novelties
qui semblaient, à tort,	which seemed, erroneously,
contredire les notions	to contradict the notions
sur le mécanisme celeste	on the divine mechanism
contenues dans la Bible,	contained in the Bible,
fut bientôt rassuré par la piété	was soon reassured by the
sincère et supérieure de Colomb.	sincere and exalted piety of Columbus.
Il cessa de craindre un blasphème	He ceased to apprehend blasphemy
dans des idées qui agrandissent	in ideas which magnify
l'œuvre et la sagesse de Dieu.	the works and wisdom of God.
Séduit par le système,	Enchanted with the system,
charmé par l'homme	fascinated by the man
	himself,
il obtint une audience	he obtained an audience
de ses souverains pour son protégé.	from his sovereigns for his protégé.
Colomb, après deux années d'attente,	Columbus, after waiting two years,
parut à cette audience	appeared before this audience
avec la modestie	with the modest bearing
d'un humble étranger	of a humble stranger
mais avec la confiance d'un tributaire	but confident as a vassal
qui apporte à ses maîtres	who brings to his masters
plus qu'ils ne peuvent lui donner.	a greater gift than they can give to him.
'En pensant à ce que j'étais,'	'In thinking of what I was,'
écrit-il lui-même plus tard,	he wrote himself in after years,
'j'étais confondu d'humilité ;	'I was struck dumb with humility ;
mais, en songeant à ce que j'apportais,	but, on thinking of what I brought,
je me sentais l'égal des couronnes :	I felt myself the equal of monarchs :
je n'étais plus moi	I was no longer myself,
j'étais l'instrument de Dieu,	I was the instrument of God,
choisi et marqué	chosen and appointed
pour accomplir un grand dessein.'	to accomplish a great design.'

CHAPTER XVIII.

Ferdinand entendit Colomb	Ferdinand heard Columbus
avec gravité,	with grave attention,
Isabelle avec enthousiasme.	Isabella with enthusiasm.
Elle conçut, au premier regard,	She conceived, at first sight,
et aux premiers accents,	and at the first tones of his voice,
pour cet envoyé de Dieu,	an admiration for the man
une admiration qui allait	sent from God, which
jusqu'au fanatisme,	approached fanaticism,
un attrait qui ressemblait	an attraction which was
à la tendresse.	near akin to tenderness.
La Nature avait donné	Nature had endowed
à la personne de Colomb	the person of Columbus
la séduction qui enleve les yeux,	with an attractive power, which ravished the gaze,
autant que l'éloquence	as well as the gift of eloquence
qui persuade l'esprit.	which bewitched the soul.
On eût dit qu'elle le destinait	One might say that Nature fated him
à avoir pour premier apôtre	to have for a first apostle
une reine, et que la vérité	a queen, and that the truths
dont il allait doter son siècle	with which he was about to dower his generation
devait être reçue et couvée	were to be received and nurtured
dans le cœur d'une femme.	in a woman's heart.
Isabelle fut cette femme.	That woman was Isabella.
Sa constance en faveur	Her constancy to
de Colomb ne se démentit	Columbus never belied itself
ni devant les indifférents de sa cour,	neither before the lukewarm of her court,
ni devant ses ennemis,	nor before his enemies,
ni devant ses revers.	nor before his reverses.
Elle crut en lui	She believed in him
dès le premier jour,	from the very first,
elle fut sa prosélyte sur le trône	she, (though) on the throne, became his proselyte
et son amie jusqu'au tombeau.	and friend to her dying day.
Ferdinand après avoir	Ferdinand after having
entendu Colomb,	heard Columbus,
nomma un conseil d'examen	appointed a commission of enquiry
à Salamanque	(to meet) at Salamanca
sous la présidence de	under the presidency of
Fernando de Talavera,	Fernando de Talavera,
prieur du Prado.	prior of Prado.
Ce conseil était composé	This commission was composed
des hommes les plus versés	of the most learned men
dans les sciences, divines	of science, sacred
et humaines des deux royaumes.	and profane, in the two kingdoms.
Il se rassembla	It met
dans cette capitale littéraire	in this famous literary capital
de L'Espagne,	of Spain,
au convent des dominicains.	at the convent of the Dominicans.
Colomb y reçut l'hospitalité.	Columbus here received hospitality.
Les prêtres et les religieux	Priests and men of religious orders
décidaient alors	at that time gave decisions
de tout en Espagne.	on all (questions) in Spain.
La civilisation était	Civilization dwelt
dans le sanctuaire.	in the cloister.
Les rois ne régnaient que	Kings held their crowns only
sur leurs actes, les idées	by their deeds, government
appartenaient aux pontifes.	belonged to the pontiffs.
L'Inquisition, police sacerdotale,	The Inquisition, the sacerdotal police,
surveillait, atteignait,	superintended, brought to justice
frappait jusqu'autour du trône,	and struck down, even around the throne,
tout ce qui encourait	all that incurred
la tache d'hérésie.	the brand of heresy.
Le roi avait adjoint à ce conseil	The King had added to this commission
des professeurs d'astronomie,	professors of astronomy,
de géographie, de mathématiques	geography, and mathematics
et de toutes les sciences	and of all sciences
professées à Salamanque.	taught at Salamanca.
Cet auditoire	This auditory
n'intimidait pas Colomb.	did not intimidate Columbus.
Il se flattait d'y être	He flattered himself that he would be there
jugé par ses pairs :	judged by his equals :
il n'y fut jugé que	here he only received the judgment
par ses contempteurs.	of contempt.
La première fois	The first time
qu'il comparut	that he made his appearance
dans la grande salle du monastère,	in the large hall of the monastery,
les moines et les prétendus savants,	the monks and pretended scientists,

convaincus d'avance	convinced beforehand
que toute théorie qui dépassait	that every theory beyond the range
leur ignorance ou leur routine	of their ignorance or routine
n'était que le rêve	was only the illusion
d'un esprit malade ou superbe,	of a mind diseased or overbearing,
ne virent dans cet obscure	saw nothing in that obscure
étranger qu'un aventurier	foreigner but an adventurer
cherchant fortune de ses chimères.	seeking a fortune from his fantasies.
Personne ne daigna l'écouter	All disdained to listen to him
à l'exception de deux ou trois	with the exception of two or three
religieux du couvent	of the brothers of the convent
de Saint-Étienne de Salamanque,	of St. Stephen at Salamanca,
religieux obscurs et sans autorité,	monks obscure and devoid of influence,
qui se livraient dans leur cloître	who devoted themselves in their retirement
à des études méprisées	to studies that were despised
du clergé supérieur.	by the upper clergy.
Les autres examinateurs	Others who examined
de Colomb le confondaient	Columbus confuted him
par des citations de la Bible,	by quotations from the Bible,
des prophètes, des psaumes,	from the Prophets, Psalms,
de l'Évangile et des Pères de L'Eglise,	Gospels, and ancient fathers,
qui pulvérisaient d'avance	who to-start-with pulverised
par des textes indiscutables	by indisputable texts
la théorie du globe	the theory of the globe
et l'existence chimérique	and the fabulous and impious
et impie des antipodes :	existence of the Antipodes :
Lactance, entre autres,	Lactance, among others,
s'était expliqué formellement	had given a formal explanation
à cet égard dans un passage	with regard to this matter in a passage
que l'on opposait à Colomb.	which men urged on Columbus.
' Est-il rien de si absurbe,'	' Is there anything so silly,'
avait dit Lactance,	Lactance had said,
' que de croire qu'il y a	'as to believe that there are
des antipodes ayant leurs pieds	any antipodes with their toes
opposés aux nôtres,	opposite to ours,
des hommes qui marchent	(where) men who parade along
es talons en l'air et la téte	with heels in the air and head
en bas, une partie du monde	on the ground, (that there is) a part of the world
où tout est à l'envers	where all is upside down,
où les arbres poussent	where trees strike
avec les racines en l'air	root in the air
et les branches en bas ? '	and their branches sink into the soil ? '

Notes.

CHAPTER XV.

Les hommes ont *des* oreilles, but *negatively*, les hommes *n'*ont *pas d'*oreilles pour, etc.

CHAPTER XVI.

À travers son humble, etc. *Au travers de* = through, across; *à travers*, omit *de*. Translate: *His scientific relations brought him near to distinguished persons.*

CHAPTER XVII.

Note, j'ai *pensé* (no preposition) tomber = I was nearly falling. Il *pensait à* me surprendre = he thought of surprising me.

A quoi pensez-vous *de* faire cela? What are you thinking of (= à) to (*de*) do that. Il l'a fait sans *y* (dative) *penser* = he did it without thinking of-it (= y). Qu'*en* pensez-vous? What do you think *of-it* (= en)?

CHAPTER XVIII.

Translate: *He had* (faire) *a room reserved for Henry* (Henri). *He was going to gift his age with truth. The priests decided everything. Is there anything so absurd as to believe? From house to house. Tache* = spot: *tâche* = task: *tacher* = to spot: *tâcher* = to try. *Personne ne* (= nobody) at the beginning of the sentence, but *ne personne* elsewhere. Son éloquence *que* passionnait *la vérité*, observe the position of *la vérité*. *En* (= *as*) hôte.

(To be continued.)

—o—

The Musical Instrument (Violin) Maker of Cremona.

Scène X.	Scene X.
Filippo, Maître Ferrari.	
Filippo.	
[*à part.*	[*aside.*
Le sacrifice est fait. Ah ! qu'il faut de courage !.....	The sacrifice is made. Ah ! how much courage is wanted !.....
[*haut à Maître Ferrari.*	[*aloud to Master Ferrari.*
Vous n'allez donc pas voir couronner son ouvrage ?	You are not going then to see the prize awarded to his work ?
Master Ferrari.	
Si, je pars. Mais Sandro n'a pas le prix encor,	Yes, I am starting. But Sandro has not got the prize yet,
Et toi-même, tu peux gagner la chaîne d'or.	And you yourself may win the golden chain.
As-tu moins de talent et moins d'intelligence	Have you less skill and less intelligence
Que lui ?.....	Than he ?.....
Filippo.	
Non, vous savez, moi, je n'ai pas de chance.	No, you know well, that I have no chance.
Master Ferrari.	
Tu doutes trop de toi, sans te le reprocher.	You mistrust yourself, be it said without reproach.
Pour n'être pas, sans doute, aussi droit qu'un clocher	Although you are, no doubt not as straight as a church-steeple
Tu n'es pas un moins bon luthier, et par la messe !	You are not the less a good instrument-maker, and by the mass !
Si le prix est pour toi, je tiendrai ma promesse,	If the prize is yours, I shall keep my promise,
Et je te choisirai pour gendre et successeur.	And choose you for my son-in-law and successor.
Filippo.	
Maître.....	Master.....
Master Ferrari.	
Laisse-moi donc, je suis fin connaisseur,	Leave me alone, I am a perfect judge,
Et tu ferais, je crois, un homme de ménage.	And you would make, I think, a good steward.
Tiens, lorsque j'ai pris femme, ayant deux fois ton âge	Look, when I married, being twice your age,

Et qu'en cet atelier je me suis établi,
Vraiment, je n'étais pas non plus joli, joli.....
Pas mal, mais comme on dit, la beauté chiffonnée.
Ma femme,—elle touchait à sa vingtième année,—
Etait assez coquette, et c'était dangereux.
Bien des jeunes seigneurs s'en montraient amoureux:
Ils poussaient par ici toutes leurs promenades,
Et, le soir, lui venaient donner des sérénades.
Mais admire à présent à quel point le hasard
Sauvegarde l'honneur des hommes de notre art.
A tous ces beaux messieurs aux manières câlines,
Je vendais dans le jour de bonnes mandolines
Et la nuit, bien couché, je dévinais au son
De l'instrument, celui qui donnait la chanson,
De sorte que, paisible et sans peine importune,
J'ai surveillé ma femme et j'ai fait ma fortune.
Mais, diable ! il ne faut pas oublier le concours !.....
Ma canne.....je dois être en retard, et j'y cours.

[*Il sort à droite.*

And when I established myself in this work-shop,
Really, I neither was handsome, handsome.....
Not bad looking, but as they say, the beauty with a queer look about me.
My wife,—she was near twenty,—
Was rather coquettish, and that is dangerous.
Many a young nobleman fell in love with her ;
They passed near here on all their walks,
And in the evening they came to serenade her.
But admire now to what point hazard (chance)
Protects the honour of men of our art.
To all these fine gentlemen with insinuating manners,
I sold during the day good mandolins,
And in the night, very comfortable in bed, I guessed from the sound
Of the instrument, him who sung the song,
So that peacefully and without importunate trouble
I watched over my wife and made my fortune.
But, the d——! We must not forget the competition !.....
My stick.....I must be late and I run there.

[*Exit to the right.*

Scène XI.

Filippo, puis Giannina.

Scene XI.

Filippo, then Giannina.

Filippo.

Il me tarde déjà que tout se réalise.

[*Apercevant Giannina qui entre au fond, portant une mantille et tenant à la main un livre de prières.*

I long for the whole affair to be over.

[*Perceiving Giannina, who enters from the back, carrying a mantilla and holding in the hand a prayer-book.*

Giannina.

Filippo, je reviens de l'eglise.
J'allais—pardon, j'ai tant chagrin dans le cœur !—
Prier pour que Sandro, malgré tout, fût, vainqueur ;
Mais, en m'agenouillant devant sainte Cécile,
Voyez-vous, j'ai senti comme il est difficile
De demander jamais rien d'injuste au bon Dieu.
Et quoi qu'il arrivât, mon ami, j'ai fait vœu
Pour vous et pour toujours de demeurer la même.
Au revoir.....A bientôt !.....

[*Elle traverse la scène et sort à droite.*

Filippo, I come from church.
I went—pardon me, my heart is filled with grief !
To pray for Sandro, that he after all might be victor ;
But, whilst kneeling before St. Cecilia,
You see, I have felt how hard it is
To ask ever anything unjust from our gracious God.
And whatever may happen, my friend, I made a vow
To remain always the same towards you.
Good bye.....I shall see you soon again !.....

[*She passes over the stage and exit to the right.*

Scène XII.

Filippo.

[*seul.*

Hélas ! comme elle l'aime !
Et si j'avais été tel que lui, fort et beau,
Comme elle m'eût aimé !.....

Scene XII.

Filippo.

[*alone.*

Alas ! how she loves him !
And if I had been like him strong and handsome,
How she would have loved me ! .....

Scène XIII.

Filippo, Sandro.

Scene XIII.

Filippo, Sandro.

Sandro.

[*entrant précipitamment par le fond, dans le plus grand trouble.*

Filippo ! Filippo !.....

[*entering hurriedly through the back of the stage in the greatest trouble (confusion).*

Filippo ! Filippo ! .....

Filippo.

Quoi ! des pleurs dans tes yeux ! ta figure blêmie !
Que t'arrive-t-il donc ?

What ! Tears in your eyes ! Your face quite pale !
What has happened ?

Sandro.

J'ai fait une infamie,
Je suis un scélérat...Pardon ! Pardon !...Pardon !...

I have done an infamous action,
I am a villain...Pardon me ! ...Pardon me !...Pardon me !...

Filippo.

Quoi ? Moi, te pardonner, mon ami ? Et quoi donc ?

Who ? I, I pardon you, my friend ! And what, pray ?

Sandro.

Vois-tu, je l'aimais trop... j'avais l'âme obsédée !.....
Et je ne pouvais pas me faire à cette idée
Qu'un rival, quel qu'il fût, pût me vaincre à ses yeux.
Je suis un misérable, un lâche, un envieux.
Lorsque j'eus ton chef d'œuvre en mes mains, c'est infâme !
Mais la tentation se glissa dans mon âme ;
J'avais le cœur perdu de rage et de douleur,
J'ai cédé !...Près d'ici, tremblant comme un voleur,
Sous l'ombre d'un portail des ruelles étroites,
Filippo, j'ai changé nos violons de boîtes !

You see, I loved her too well ...my soul was beset !...
And I could not reconcile myself to the idea
That a rival, whoever he might be, should outdo me in her eyes.
I am a wretch, a coward, an envious man.
When I had your masterpiece under my hand, it is infamous !
But the temptation entered my heart ;
My heart was devoured with rage and grief,
I fell (gave way) !...Near here, trembling like a thief,
In the shadow of a gateway in the narrow streets,
Filippo, I have changed the violins in their cases.

Filippo.

Toi ?

You ?

Sandro.

Je les ai portés devant les juges, puis
Au moment où l'expert ouvrait les deux étuis,
Ah ! je n'ai pas pu voir cela. J'ai pris la fuite.
Venge-toi ! Devant tous, dévoile ma conduite !

I brought them before the judges, then
At the moment when the expert opened the two cases,
Ah ! I could not look at that. I took to flight.
Revenge yourself ! Before all of them unveil my conduct !

Mais qu'elle n'en soit pas, par pitié, le temoin !
Je t'écrirai l'aveu du crime et puis bien loin
Je m'en irai mourir, car la honte est mortelle...
Mais ne m'oblige pas à rougir devant elle !

But, for mercy's sake let her not be witness of it !
I shall write to you the confession of the crime and then far away
I shall lie down and die, for disgrace is mortal (deadly).....
But do not oblige me to blush before her !

[*Il tombe à genoux.*

[*He falls on his knees.*

Filippo.

Non, Sandro, je n'ai pas besoin de me venger.
Ton propre châtiment, tu viens de t'en charger.

No, Sandro, I have no need to avenge myself.
Your own chastisement you have just taken upon yourself.

Sandro.

Que dis-tu ?

What say you ?

Filippo.

Cette gloire, à mon chef-d'œuvre due,
Je te l'avais cédée et tu me l'as rendue.

That renown due to my masterpiece
I had given up to you, and you have given it back to me.

Sandro.

Comment ?

What ?

Filippo.

Ces instruments que ta main échangea,
Moi-même je les ai changés d'étuis déjà.

These instruments which your hand interchanged,
I myself had changed them in their cases.

Sandro.

Qu'entends-je ! Mon remords n'ose comprendre encore !
Pourquoi l'avais-tu fait ?

What do I hear ! I dare not yet think of it for remorse!
Why did you do it ?

Filippo.

Parce que je l'adore
Et parce que c'est toi que l'enfant préférait,
Et si j'ai le cœur plein d'un douloureux regret,
Si de ton action je te cherche querelle,
C'est qu'elle anéantit ce que j'ai fait pour elle.

Because I worship her
And because it is you whom the child prefers,
And if my heart is full with grievous regret,
If I pick a quarrel with you on account of your deed,
It is because it undoes what I did for her.

Sandro.

[*se relevant.*

Non, j'ai commis un crime, et je m'en veux punir.
Dis un mot, et je pars pour ne plus revenir.
Si Giannina m'oublie...eh bien ! je me résigne.....
Tu t'en feras aimer, car toi seul en es digne.....
Je pars...je dois partir...

[*rising.*

No, I have committed a crime and will punish myself for it.
Say one word, and I shall go, not to return again.
If Giannina forgets me... well ! I resign myself...
You will make her love you, for you alone are worthy of her...
I go...I must go...

[*Tumulte au dehors.*

[*Tumult outside.*

Filippo.

Non. Reste. Obéis-moi !

No. Stay. Obey me !

Scène XIV.

Scene XIV.

Tous.

All.

Maître Ferrari entre au fond et lève les bras au ciel en apercevant Filippo. Il est suivi de toute la corporation des luthiers et de deux pages aux couleurs de la ville, portant l'un la chaîne d'or du Podestat sur un coussin, l'autre le violon de Filippo, orné de rubans et des fleurs. Giannina paraît sur le seuil de la porte de droite.

Master Ferrari enters through the back and raises his arms towards heaven on perceiving Filippo. He is followed by the whole corporation of instrument-makers and by two pages (dressed) in the colours of the town, bearing, the one the golden chain of the Podesta on a cushion, the other Filippo's violin, adorned with ribands and flowers. Giannina appears on the threshold of the door on the right.

Vivat !

Hurrah !

Master Ferrari.

[*à Filippo.*

Viens dans mes bras ! Je te proclame roi
Du métier, lauréat et maître ès-lutherie,
Et sur-le-champ, devant toute la confrérie,
Je vais d'abord tenir ma promesse au vainqueur.
Donc, mon associé, mon gendre, sur mon cœur !...
...Mais avant tout...Voilà que je me le rappelle...
[*prenant la chaîne et s'avançant vers Filippo.*
La chaîne d'or.....

[*to Filippo.*

Come to my arms ! I proclaim you king
Of the profession, laureate and master of instrument-makers,
And at once, before all the brotherhood
I am going first to keep my promise towards the victor.
Therefore, my partner, my son-in-law, come to my heart !...
...But before all...I just remember...
[*taking the chain and advancing towards Filippo.*
The golden chain.....

Filippo.

[*la lui prenant des mains et allant la mettre au cou de Giannina.*
Je l'offre à Giannina la belle,
En la priant d'en faire un bijou favori,
Quand mon ami Sandro deviendra son mari.

[*taking it from his hands and putting it round Giannina's neck.*
I offer it to Giannina the beautiful.
In begging her to make a favourite trinket of it,
When my friend Sandro will become her husband.

Giannina.

Bon Filip !

Kind Filip !

Sandro.

[*à voix basse, à Filippo.*
Mon noble ami, mon frère !

[*sotto voce to Filippo.*
My noble friend, my brother!

Master Ferrari.

Halte !
Tu n'as point fait tes vœux de chevalier de Malte !
Et tu pense l'épouser...

Hold !
You have not made your vows of a Knight of Malta!
And you are thinking of marrying.....

Filippo.

Non, mon bon maître, non.
Je veux aller au loin porter votre renom,
Et dès demain je pars pour mon tour d'Italie.
Voyez vous, j'avais fait un rêve...une folie !...
Et ce qui pouvait être enfin n'a pas été.
Oui, je pars, trop heureux si je suis regretté

No, dear master, no.
I am going to carry your renown afar,
And not later than tomorrow I start on my Italian tour.
You see, I dreamed a dream ...a folly !...
And that which might have been some time has not come to pass.
Yes, I go, too happy if I am regretted

Et suivi du regard comme les hirondelles...	And followed by your regard like the swallows...
Je ne demande pas de souvenirs fidèles,	I do not ask for faithful remembrance
Seulement un regret...c'est plus que je ne vaux.	Only for a regret...it is more than I deserve.
[*Attirant vers lui Sandro et Giannina.*	[*Drawing towards him Sandro and Giannina.*
Et lorsque l'atelier reprendra ses travaux	And when in the workshop you take up your work again.
Et qu'à notre établi, près de ta bien-aimée,	And when at our bench, near your well-beloved,
Compagnon, tu feras ta tâche accoutumée,	Companion, you will do your accustomed task,
Si quelque corde, ainsi qu'il arrive parfois,	If some string, as it sometimes happens,
Avec un son plaintif se brise entre tes doigts,	With a plaintive sound breaks between your fingers,
Songez tous deux, songez qu'en cet adieu suprême,	Remember, both of you remember, that in this last farewell,
Je sens mon pauvre cœur qui se brise de même !...	I feel my poor heart breaking too !...
Je sais, mes bons amis, que vous n'y pouvez rien...	I know, my good friends, that it is through no fault of yours...
Mais n'oubliez jamais que je vous aimais bien !	But never forget that I loved you well !
Master Ferrari.	
Ingrat ! Mais tu veux donc que ma maison périsse ?	Ungrateful man ! But do you wish my house to perish ?
Filippo.	
Je vous laisse Sandro.	I leave you Sandro.
Master Ferrari.	
Quel étrange caprice !	What a strange whim !
Tu plantes là bonheur, fortune, et cœtera...	You abandon happiness, fortune, &c. ...
Que gardes-tu ?	What do you keep ?
Filippo.	
[*saisissant son violon.*	[*taking up his violin.*
Ceci,	This.
[*à part.*	[*aside.*
qui me consolera.	which will console me.

Notes.

SCENE X.

Qu'il faut de courage = Que de courage = how much (of) courage, il faut, there is needed, *que* takes *de* only: but *il faut du courage* = there needs some courage. Moi, je = as-to-myself, I.

SCENE XI.

J'allais prier *pour que* Sandro *fût* (subj. after *pour que*). *Quoi que* takes *subj.*

SCENE XII.

Moi, te pardonner ! The infin. is used in exclamations. *Me faire* = *m'accoutumer*. *Quel que* takes *subj.* *Changer de chevaux* = to change horses ; but *échanger* takes *accusative.*

SCENE XIV.

Maître *ès*-lutherie, *ès* for *en les* and the *s* is pronounced in ès. We say je me *le* (*acc.*) rappelle but je m'*en* (*gen.*) souviens.

Chevaliers de Malte took a vow of celibacy.

Translate into French :—

One day when Charles XII., King of Sweden, was dictating (dicter) some letters to his secretary, a bomb fell on the house, pierced the roof, and burst near the king's chamber; half the floor fell to pieces, and, by astonishing good luck, not one of the pieces which went into the air entered the room the door of which was open. At the sound of the shell and the noise of the house, which seemed about to fall, the pen dropped from the hands of the secretary : 'What is the matter?' said the king to him in a calm manner, 'Why do you not write?' The latter could only utter these words: 'Sire, the shell!' 'Well,' replied the king, 'What has the shell in common with what I am dictating to you?'

(*The end.*)

Mental Arithmetic, its Principles and Practice.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' 'Tips in Algebra,' 'Easy Steps in Trigonometry,' etc., etc.

ANSWERS TO EXERCISES.

CHAPTER XVIII.

1. £194
2. £198 5s. 3d.
3. £82 6s.
4. £222 10s. 1d.
5. £631 9s.
6. £219 5s.
7. £283 15s. 10d.
8. £347 10s. 10½d.
9. £407 17s. 11d.
10. £84 5s. 10d.
11. £18 0s. 6d.
12. £75
13. £163
14. £25 10s.
15. £18 18s.
16. £17 3s. 1½d.
17. £15 16s. 3d.
18. £31 12s. 6d.
19. £8
20. £45
21. £91
22. £925 13s. 4d.
23. £381 16s. 6d.
24. £630 6s.
25. £595 18s. 6d.
26. £311 4s. 9d.
27. £565 6s. 3d.
28. £475 10s.
29. £277 10s.
30. £452 9s.
31. 4 per cents.
32. 7 ,,
33. 2½ ,,
34. 3 ,,
35. 3 ,,
36. 4 ,,
37. 3 ,,
38. 3 ,,
39. 3 ,,
40. 5 ,,
41. 95
42. 92½
43. 93
44. 93
45. 82
46. 94
47. 82
48. 96
49. 91
50. 91

CHAPTER XIX.

1. £503
2. £628 15s.
3. £814
4. £795
5. £570
6. £625
7. £27 10s.
8. £364
9. £307 15s.
10. £1,208 8s.
11. £536 1s.
12. £641 11s.
13. £596 1s.
14. £429 11s.
15. £650 13s.
16. £700 14s.
17. £125 5s.
18. £450 18s.
19. £225 9s.
20. £394 1s.
21. 80⅝
22. 105$\frac{5}{16}$
23. 53⅜
24. 89½
25. 78¾
26. 63⅜
27. 94⅜
28. 82½
29. 81⅛
30. 107⅞
31. £520
32. £855
33. £1,683
34. £1,615 7s. 1d.
35. £7,371
36. £1,863 13s. 6d.
37. £1,470 6s. 1½d.
38. £2,006 9s. 10d.
39. £9,994 17s. 6d.
40. £15,345
41. 139½
42. 92
43. 92
44. 103
45. 99
46. 77
47. 85
48. 107
49. 100½
50. 102⅜

Note.—In Ex. 39 for £9,717 read £9,217, and in Ex. 41 for £1,679 read £1,426.

CHAPTER XX.

1. £50
2. £1
3. £2
4. 5s.
5. 10s.
6. £2
7. No difference
8. 10s.
9. £1
10. £1
11. £115 10s.
12. £600
13. £300
14. £116 5s.
15. £53 11s.
16. £17 10s.
17. £56 2s.
18. £21
19. £68
20. £117
21. Increase by £3 6s. 8d.
22. Decrease by £10
23. Increase by £12 10s.
24. ,, £2
25. ,, £1
26. ,, £4
27. Decrease by £34
28. Increase by £40 10s.
29. Decrease by £22 15s.
30. Increase by £8 18s. 9d.

31. £108
32. £14 10s.
33. 80
34. £2$\frac{1}{2}$
35. £400 at 5 per cent. and £500 at 4 per cent.
36. The 4 per cents. at 99 by £$\frac{1}{24}$ on each pound
37. £40
38. £1,760
39. £15,900
40. £18,560
41. 104$\frac{1}{2}$
42. £462
43. 96
44. £4,250
45. £19,200
46. £2,400
47. £2,550
48. 5d. in the pound
49. 92
50. No difference

Note.—In Ex. 3 for £864 read £624.

CHAPTER XXI.

FRACTIONS.

181. Many operations in fractions can be performed mentally.

182. In the addition of two fractions, even if the denominators have a common factor, it is easier to reduce them to the denominator which is the product of the two denominators before adding, and reduce the sum, thus:

$$\frac{5}{6} + \frac{7}{8} = \frac{40 + 42}{48} \text{ or } \frac{82}{48} \text{ or } 1\frac{17}{24}.$$

183. Again, in the subtraction of one fraction from another, I should reduce the fractions to the denominator which was the product of the two denominators, reducing the result, thus:

$$\frac{5}{1\frac{1}{2}} - \frac{3}{8} = \frac{40 - 36}{12 \times 8} \text{ or } \frac{1}{24}.$$

184. In the above example, I should retain the number 12×8 mentally in that form and not as 96.

185. The inverse of a fraction, as $\frac{3}{5}$ of $\frac{5}{3}$ or $\frac{3}{7}$ of $2\frac{1}{3}$ is called its reciprocal, and is found by dividing 1 by the fraction.

186. Many mental problems in arithmetic become very easy when a thorough meaning of a reciprocal has been grasped; *e.g.*, if $\frac{3}{5}$ of anything is worth, say, £201, the whole thing is worth $\frac{5}{3}$ of £201 or £335.

187. The best way perhaps to understand the origin and meaning of the term reciprocal is to conceive of two individuals, whom we will call A. and B., having certain sums of money, as £5 and £7 respectively, and to compare what fraction of B.'s money A.'s is, and *vice versa*. Since B. has £7, each of his pounds is $\frac{1}{7}$ of his money; but A. has £5. ∴ A.'s money is $\frac{5}{7}$ of B.'s

Again, each of A.'s pounds is $\frac{1}{5}$ of his money, and B. has £7. ∴ B.'s money is $\frac{7}{5}$ of A.'s money.

108. Students who know anything of Algebra, and the working of simple equations will see at once that if $\frac{3}{5}x = y$, $x = \frac{5}{3}y$.

189. Here is a question which can be done easily without the aid of paper, involving a subtraction, and the principle of reciprocity. If a man and a boy can accomplish a piece of work in 7 days which the boy would do alone in 16 days, how long would the man take to do it?

Together they do $\frac{1}{7}$ each day.
The boy does $\frac{1}{16}$ each day.

∴ the man does $\frac{9}{7 \times 16}$ each day, and would take $\frac{7 \times 16}{9}$ or $12\frac{4}{9}$ days to do it by himself.

190. We can often save ourselves the retention of large numbers by resolving a fraction into two terms, one of which at least is capable of reduction into small numbers, *e.g.*, to find the difference between $\frac{19}{34}$ and $\frac{21}{36}$, we can resolve the former fraction into $\frac{1}{2} + \frac{2}{34}$, and the latter into $\frac{1}{2} + \frac{3}{36}$. All then we have to do is to find the difference between $\frac{1}{17}$ and $\frac{1}{18}$, or $\frac{1}{306}$.

191. EXAMPLES XXI.

Write down the results of the ten following operations:—

1. $\frac{3}{4} + \frac{1}{8}$
2. $\frac{3}{4} + \frac{3}{11}$
3. $\frac{5}{8} + \frac{1}{12}$
4. $2\frac{1}{2} + 3\frac{1}{3}$
5. $\frac{4}{7} + 3\frac{3}{13}$
6. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4}$
7. $\frac{1}{2} + \frac{1}{3} + \frac{1}{6}$
8. $\frac{1}{2} + \frac{2}{7} + \frac{3}{8}$
9. $2\frac{1}{2} + 3\frac{1}{3} + 4\frac{1}{4}$
10. $3\frac{1}{5} + 4\frac{1}{4} + 5\frac{1}{8}$

Write down in single fractions the following differences:—

11. $\frac{1}{7} - \frac{1}{8}$
12. $1\frac{1}{3} - 1\frac{1}{5}$
13. $2\frac{1}{2} - 1\frac{1}{3}$
14. $3\frac{1}{2} - 1\frac{1}{3}$
15. $2\frac{1}{13} - 1\frac{7}{13}$
16. $13\frac{1}{11} - 8\frac{7}{11}$
17. $1000\frac{1}{2} - \frac{3}{4}$
18. $\frac{17}{21} - \frac{13}{42}$
19. $3\frac{1}{17} - 1\frac{2}{306}$
20. $1\frac{1}{2} - \frac{8}{14}$

In the ten following cases adopt the artifice explained in 190:—

21. $\frac{1}{2} + \frac{3}{4} - \frac{11}{12}$
22. $\frac{3}{4} + \frac{1}{2} - \frac{15}{16}$
23. $\frac{4}{5} + \frac{9}{10} - \frac{17}{20}$
24. $\frac{5}{6} + 1\frac{1}{2} - \frac{8}{10}$
25. $3\frac{2}{3} + \frac{1}{5} - 3\frac{13}{15}$
26. $\frac{7}{11} + \frac{1}{2} - \frac{14}{44}$
27. $3\frac{1}{2} + \frac{1}{3} - 2\frac{7}{12}$
28. $2\frac{1}{2} + 3\frac{1}{3} - 5\frac{14}{15}$
29. $12\frac{2}{3} + 23\frac{1}{5} - 25\frac{13}{15}$
30. $4\frac{1}{4} + 5\frac{2}{5} - 82\frac{21}{21}$

31. If a man and a boy can do a piece of work in 8 days which the man can do in 13 days, in how many days could the boy do it alone?

32. If 17 men had provisions for 3 days, but 13 boys coming in, the men and boys consume them in 2 days, what fraction of the provisions does a boy consume each day?

33. If a man consumes in 5 days what a woman does in 4 days, how long will 4 men and 5 women take to consume what 12 men consume in 6 days?

34. If 7 men and 7 boys consume a barrel of flour in 200 days, which the men alone could consume in 350 days, how long would the boys take to consume it?

35. A number of men and 1 boy take 15 days to consume what the men alone could consume in 16 days; in how many days would the boy alone take to do it?

36. A number of men would consume in 9 days what some boys would consume in 72 days; in how many days would they consume it together?

37. A certain number of men would finish the same piece of work which the same number of women would finish in twice the time, and which the same number of children would finish in thrice the time. If the men could complete it in 55 days, how long would the women and children take to complete it if they worked together?

38. Using the same conditions as in 37, how long would the men, women and children, all working together, take to finish it?

39. With the same conditions as in 37, if six men could complete it in eight days how long would 12 men, six women and three children take to complete it?

40. By how much is $\frac{3}{4}$ greater than $\frac{1}{4}$.

41. What fraction must I add to $\frac{3}{4}$ to obtain $\frac{11}{11}$?

42. What fraction of a pound is 2s. 9d.?

43. What fraction of 2s. 9d. is 2s. 3d.?

44. What fraction of a guinea is the difference between $\frac{1}{2}$ of half-a-crown and $\frac{1}{2}$ of a florin?

45. What is the least number of marbles a master could distribute amongst 100 children, of which two-fifths were girls, so that if after every child had received the same number of marbles every boy gave a marble each to five of the girls, then the number of marbles owned by all the boys was the same as that owned by all the girls?

46. In 45 how many would the girls have had to give to the boys that the sum of all those owned by the boys was double that of those owned by the girls?

47. If A. can give B. 10 yards in a 100 yards race, and B. can give C. 10 yards in a 100 yards race, how many yards can A. give C. in a race of 100 yards?

48. If I walk five miles an hour to a train, I am 10 minutes too soon, but if I only walk four miles an hour, I am five minutes too late; how far is it?

49. If by walking five miles an hour I am an hour too late for a train, but by walking six miles an hour I am one hour too soon, how far is it?

50. By how much faster do I walk when I cover 10 miles in two hours than when I cover 22 feet in five seconds?

CHAPTER XXII.

DECIMALS.

192. The student is supposed to know the principles of pointing decimals, and he has frequently, in former exercises, been expected to place the decimal point in multiplications and divisions and approximate roots.

193. Since the tenth of a pound is 2s., we know that the first decimal place of a decimal of a pound represents so many florins. Unfortunately the hundredth of a pound is not an exact number of pence or farthings, but $2\frac{3}{5}$d.; and a thousandth of a pound is $\frac{24}{25}$ of a farthing. Under certain circumstances only, then, can we write down the value of the decimal of a pound. *e.g.* £4·265625 is equivalent to £4, 2 × 2s., or 4s. + 5 × $2\frac{3}{5}$d. or 1s. + $\frac{625}{1000}$ of $\frac{24}{25}$ of a farthing or $\frac{625}{1000}$ of 6 pence, or $\frac{25}{40}$ of 6 pence, or $\frac{30}{8}$ pence, or $3\frac{3}{4}$d.; hence £4·265625 = £4 5s. $3\frac{3}{4}$d. The second figure being greater than 5 we practically reduce ·265625 to ·25 + ·015625.

194. Similarly in the expression ·890625 tons we see at once that ·85 tons is 17 cwts.; ·040 tons is $3\frac{2}{10}$ qrs., and $\frac{625}{1000000}$ tons, or $\frac{25}{40000}$ tons, or $\frac{1}{1600}$ tons = $\frac{80}{1600}$ qrs., *i.e.*, $\frac{1}{20}$ qr.; and since $\frac{2}{10} + \frac{1}{20} = \frac{5}{20}$, or $\frac{1}{4}$ qr., we can write down that

·890625 tons = 17 cwt. 3 qrs. 7 lbs.

195. It is useful to be able to write down the equivalent vulgar fraction to a recurring decimal. Since all we have to do is to multiply by some number of nines, followed, or not, by cyphers, we can use the artifice explained in a former chapter for such multiplications, and this is practically the rule found in all arithmetics. *e.g.* Reduce to a vulgar fraction the decimal $3\dot{4}\dot{7}$. It is equivalent to $\frac{34\frac{7}{9}}{10}$ or $\frac{347-34}{90}$ or $\frac{313}{90}$ and this is the better form to leave it in.

196. The difference between a pure circulating decimal and its corresponding finite decimal is sometimes asked for.

$$\dot{3}\dot{5} - 35 = 00\dot{3}\dot{5}$$

since I can write $\dot{3}\dot{5}$ as ·3535 and ·00$\dot{3}\dot{5}$ = $\frac{35}{9900}$; and this operation the student can easily reduce to a rule if he wish.

197. Similarly $2\cdot1\dot{3}\dot{5} - 2\cdot135 = \frac{35}{99000}$.

198. Some of the questions in the succeeding set of examples may be considered as a recapitulation of some of the preceding exercises, though they will all involve a knowledge of decimals.

199. EXAMPLES, XXII.

Write down the value of the following twenty expressions.

1. £3·5
2. £3·475
3. £13·625
4. £5·7125
5. £6·3875
6. £17·86875
7. £3·284375
8. £17·609375
9. 5·375 shillings
10. 5·7375 five pounds
11. 4·75 tons
12. 3·25 miles
13. 4·125 acres
14. 3·7125 tons
15. 15·79375 tons
16. 3·96875 miles
17. 4·3125 oz. Av.
18. 3·825 acres
19. 3·18125 oz. Troy
20. 7·13125 oz. Apoth.

Write down the equivalent vulgar fractions to the ten following recurring decimals.

21. $3\cdot\dot{7}\dot{5}$
22. $4\cdot44\dot{3}$
23. $15\cdot2\dot{7}\dot{1}$
24. $6\cdot23\dot{5}$
25. $3\cdot047$
26. $\cdot00\dot{8}\dot{3}$
27. $\cdot3\dot{5}\dot{7}\dot{5}$
28. $\cdot0\dot{6}8\dot{5}$
29. $13\cdot0\dot{1}\dot{3}$
30. $25\cdot56\dot{7}\dot{8}$

Write down the following expressions as single decimals or vulgar fractions.

31. ·479 − ·479
32. 424 ÷ ·477
33. 325515 × 6·6
34. $\sqrt{94\frac{1}{9}} \div \cdot7$
35. $\sqrt{\cdot00144}$ to four places of decimals
36. 5·79 + 5·38
37. 3·75 × 1·0101
38. 627·238 × 9·9
39. $\sqrt{18\frac{1}{16}} \times \cdot4$
40. 22·12 ÷ 77·7
41. 8580 ÷ ·010296
42. ·3045 ÷ 201
43. $\sqrt{\cdot321}$
44. £34750 × ·625
45. Square of 10·15
46. ,, 1·471
47. $(7\cdot1)^2 - (6\cdot9)^2$
48. $(\cdot61)^2 - (\cdot59)^2$
49. $(6\cdot3)^2 + (4\cdot7)^2$
50. $(40\cdot72)^2 - (3\cdot028)^2$

CHAPTER XXIII.

PROPORTION.

200. In finding any term of a proportion of which the other three are given, since we multiply two terms together and divide by the third, we must look for factors which are common to one of the two former and the latter.

201. Many of the Exercises given in earlier chapters are really questions in proportion, though solved by means of fractions; *e.g.*, what is the net income of a person after paying a tax of 4d. in the pound on £840? We previously solved this by multiplying the sum by $\frac{236}{240}$ or $\frac{59}{60}$. Stated as a proportion it becomes £1 : 19s. 8d. = £840 : £x, and reducing the first two terms to fourpences we find the fourth term thus:

£$\frac{840 \times 59}{60}$, which involves precisely the same working as the other.

202. If asked to find a third proportional we have only to imagine the second quantity repeated for the third. *E.g.*, find a third proportional to 48 and 64. We must imagine 48 : 64 = 64 : x, from which $x = \frac{8.8.8.8}{8.6}$ or $\frac{256}{3}$.

203. A few examples will be given of finding a mean proportional between two numbers, the method of finding which was discussed in the chapter on Square root.

204. EXAMPLES XXIII.

Find the wanting term in the ten following proportions.

1. 93 : 217 = 69 : ?
2. 132 : ? = 671 : 427
3. 244 : 427 = ? : 308
4. 405 : 243 = 75 : ?
5. 105 : 63 = ? : 99
6. 343 : ? = 357 : 561
7. ? : 268 = 137 : 67
8. $\frac{1}{2}$: $\frac{1}{3}$ = $\frac{11}{4}$: ?
9. ·03 : ·009 = ·0002 : ?
10. ·05 : ·15 = 22 : ?

Find a third proportional to the following ten pairs of numbers:—

11. 68 and 170
12. 264 ,, 660
13. 909 ,, 1212
14. 240 ,, 600
15. 308 ,, 462
16. 972 and 1296
17. 100 ,, 250
18. 3756 ,, 5634
19. 1284 ,, 1926
20. 352 ,, 880

Find a mean proportional to the following ten pairs of numbers :—

21.	459 and 816	26.	360 and 1440
22.	729 ,, 324	27.	6345 ,, 11280
23.	999 ,, 1776	28.	328 ,, 738
24.	1274 ,, 1664	29.	$\frac{1}{4}$,, 5·3
25.	1127 ,, 2753	30.	$44\frac{8}{9}$,, 567.

31. If eight men can perform a piece of work in 15 days, how many could perform it in 24 days?

32. If 70 workmen can build a house in 200 days how many can do the same amount in 25 days?

33. If a person travelling 12 hours a day complete a journey in six days, how many days will the return journey occupy, travelling eight hours a day?

34. If 500 men have provisions for six weeks, how many weeks would the same provision last 800 men?

35. What is the price of 376 acres of land, if 240 acres cost £900?

36. A bankrupt owes £4,680 18s. and has but £1,040$\frac{1}{2}$ to pay it with; how much can he pay in the pound?

37. It costs 5 guineas to have 12 tons 6 cwts. carried 325 miles, how much will it cost to have it carried 130 miles?

38. What must I add to the first term of the ratio 11 : 25 to make it equal to 38 : 40?

39. What must a man earn per annum if he spent £86 every 73 days and save £70 every year?

40. What fraction contains $\frac{4}{5}$ as often as $\frac{10}{11}$ contains $\frac{3}{8}$?

41. What fraction is contained in $\frac{3}{4}$ as often as $\frac{3}{5}$ is contained in $\frac{9}{4}$?

42. What number contains $\frac{1}{4}\frac{1}{3}$ as often as $\frac{7}{1}\frac{1}{3}$ contains the number?

43. If $\frac{1}{2}$ a lb. cost $\frac{1}{4}$s.; what fraction of a lb. can I buy with $\frac{3}{4}$s.?

44. By how much is the ratio between 2 and 5 less than that between $\frac{3}{4}$ and $\frac{7}{1}\frac{1}{2}$?

45. By how much is the ratio between $3\frac{1}{2}$ and $3\frac{1}{4}$ less than that between $\frac{1}{4}$ and $\frac{2}{1}\frac{0}{7}$?

46. Seven men have provisions for 63 days, but being joined by a certain number of men the provisions only last 49 days; find the number that came in.

47. Find the number which is contained in 585 as often as it contains 260.

48. Find the number which contains 1575 as often as 1575 contains 1125.

49. Find the fraction which is contained in $\frac{2}{3}\frac{5}{3}$ as often as it contains $\frac{5}{8}\frac{0}{1}\frac{0}{7}$.

50. Find the fraction which contains $\frac{3}{4}$ as often as $\frac{3}{4}$ contains $\frac{3}{4}$.

(To be continued.)

Pronunciation of Latin in the Augustan Period.—With regard to our notice of this pamphlet in last month's issue, we have received a letter from the secretary of the Cambridge Philological Society, under whose auspices the pamphlet in question was published, stating that we have misunderstood one of the suggestions of the committee, viz., as to the pronunciation of the letter 'i' in certain cases. He says that when the 'i' is pronounced as if written twice, one of them is pronounced consonantally, and that so the number of syllables is unaffected. We gladly insert the correction. The letter concludes with the important piece of information that the scheme of the committee will in all probability be adopted as a whole in Cambridge this Term. Let it be so, and let it also find favour in Oxford and, as we said, we shall soon have that uniformity which above all things is so desirable. At present there are students attending lectures in Cambridge given by those who have adopted the revived method, who can scarcely understand or follow the lecturer,

Easy Steps in Trigonometry.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' etc., etc.

ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER XXII.

1. $\cos(\theta - h) - \cos\theta$
$= \cos\theta\cos h + \sin\theta\sin h - \cos h$
$= \sin\theta\sin h - \cos\theta(1 - \cos h)$
$= \sin\theta\sin h\left(1 - \cot\theta\,\frac{1-\cos h}{\sin h}\right)$
$= \sin\theta\sin h\left(1 - \cot\theta\tan\frac{h}{2}\right).$

2. When h is the C. M. of a very small angle, so that $\sin h = h$ approximately, and θ is not very small so that $\cot\theta$ is not very large, $\cot\theta\tan\frac{h}{2}$ may be neglected.

3. $\tan(\theta + h) - \tan\theta = \dfrac{\sin h}{\cos(\theta + h)\cos\theta}$
$= \dfrac{\sin h}{\cos^2\theta(\cos h - \sin h\tan\theta)}$
$= \dfrac{\tan h}{\cos^2\theta(1 - \tan\theta\tan h)}$

4. When h is so small that we may write h for $\tan h$, and when θ is not nearly $= \frac{\pi}{2}$, we may neglect $\tan\theta\tan h$.

5. $\sec(\theta + h) - \sec\theta = \dfrac{1}{\cos(\theta + h)} - \dfrac{1}{\cos\theta}$
$= \dfrac{\cos\theta - \cos(\theta + h)}{\cos\theta\cos(\theta + h)}$
$= \dfrac{\sin h\sin\theta + (1 - \cos h)\cos\theta}{\cos^2\theta(\cos h - \sin h\tan\theta)}$
$= \dfrac{\tan h\sin\theta\left(1 + \tan\frac{h}{2}\cot\theta\right)}{\cos^2\theta(1 - \tan\theta\tan h)}$

6. We must suppose h so small that we may put h for $\tan h$, also that θ is neither very small, nor very nearly equal to $\frac{\pi}{2}$, so that both $\tan\theta\tan h$ and $\cot\theta\tan\frac{h}{2}$ may be neglected.

7. If in 306 we write $\frac{\pi}{2} - \theta'$ for θ we obtain the formula at once.

8. Since $\log\sin(\theta + h) - \log\sin\theta = \mu h\cot\theta$
and $\log\cos(\theta + h) - \log\cos\theta = -\mu h\tan\theta$
by subtraction
$\log\tan(\theta + h) - \log\tan\theta = \mu h(\cot\theta + \tan\theta)$
$= \dfrac{2\mu h}{\sin 2\theta}$
$\therefore$ L $\tan(\theta + h)$ − L $\tan\theta = 2\mu h\operatorname{cosec} 2\theta$.

9. The difference = 4797
and $\frac{1}{3}\frac{1}{3}$ of 4797 = 1359
$\therefore$ L $\tan 15^\circ\,53'\,17'' = 9{\cdot}4542838$.

16. Since $a + c = 2b$
$\therefore \sin A + \sin C = 2\sin B$
$2\sin\dfrac{A+C}{2}\cos\dfrac{A-C}{2} = 4\sin\dfrac{A+C}{2}\cdot\cos\dfrac{A+C}{2}$
&c.

17. $a\cos^2\dfrac{C}{2} + c\cos^2\dfrac{A}{2} = \dfrac{s(s-c)}{b} + \dfrac{s(s-a)}{b}$
$= s$
If $a + c = 2b$
$2s = 3b$
$\therefore s = \dfrac{3b}{2}$ $\therefore$ etc.

18. If $\cot A + \cot C = 2 \cot B$

$$\frac{\sin (A + C)}{\sin A \cdot \sin C} = \frac{2 \cos B}{\sin B}.$$

$$\sin^2 B = 2 \sin A \cdot \sin C \cos B$$

$$b^2 = 2ac \frac{a^2 + c^2 - b^2}{2ac}$$

$$\text{or } 2b^2 = a^2 + c^2.$$

19. $$\tan \frac{A}{2} \tan \frac{C}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-b)} \cdot \frac{(s-a)(s-b)}{s(s-c)}}$$

$$= \frac{s-b}{s} = \frac{a+c-b}{a+b+c}$$

$$= \frac{b}{3b} = \frac{1}{3}.$$

20. See 19.

21. $$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\therefore \frac{a+b+c}{\sin A + \sin B + \sin C} = \frac{c}{\sin C}$$

$$\therefore \text{perimeter} = \frac{2c \sin \frac{A+B}{2} \left(\cos \frac{A-B}{2} + \cos \frac{A+B}{2} \right)}{2 \sin \frac{A+B}{2} \cdot \cos \frac{A+B}{2}}$$

$$= 2c \cos \frac{A}{2} \cdot \cos \frac{B}{2} \cdot \operatorname{cosec} \frac{C}{2}.$$

22. See figure to Solution of Chap. XII. Ex. 24.
AD which bisects angle A is at right angles to SR

$$\therefore \operatorname{cosec} SAB = \sec \frac{A}{2}$$

$$\text{and } \operatorname{cosec} RAC = \sec \frac{A}{2}$$

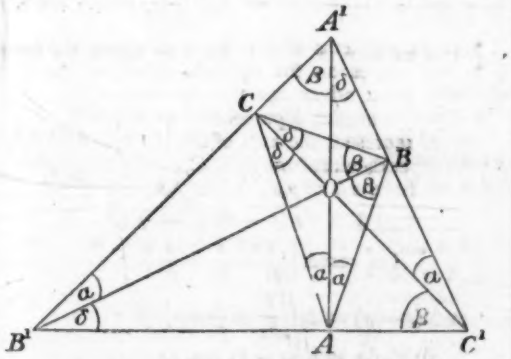
$$SR = (r_c + r_b) \sec \frac{A}{2}$$

$$= \frac{S(s-b+s-c)}{(s-c)(s-b)} \sqrt{\frac{bc}{s(s-a)}}$$

$$= \frac{a\sqrt{s(s-a)(s-b)(s-c)}}{(s-c)(s-b)} \frac{\sqrt{bc}}{\sqrt{s.s-a}}$$

$$= \frac{a\sqrt{bc}}{\sqrt{(s-c)(s-b)}} = a \operatorname{cosec} \frac{A}{2}.$$

23.



Let A'B'C' be a triangle, and let AA', BB', and CC' be the perpendiculars to the opposite sides, meeting in O.

Join AB, BC, and CA.

Let $\alpha = 90° - A'$, $\beta = 90° - B'$, and $\delta = 90° - C'$, then the angles will be as marked in the figure.

If the student have any difficulty in seeing that AA' bisects CAB, he must remember that since a circle could be drawn round OCB'A, the angles OCB' and OAB' being right angles, OAC is = OB'C. Similarly OC'B = OAB.

If ABC be considered the original triangle, the triangle A'B'C' is that formed by joining the centres of the escribed circles.

Area of $A'B'C' = \frac{1}{2} A'B' \cdot B'C' \sin A'B'C'$

$$= \frac{1}{2} ca \operatorname{cosec} \frac{C}{2} \cdot \operatorname{cosec} \frac{A}{2} \cdot \sin (90° - A' + 90° - C')$$

but $\frac{A}{2} = a = 90° - A'$

$$\therefore \sin (90° - A' + 90° - C') = \sin \frac{A+C}{2} = \cos \frac{B}{2}$$

$$\therefore \text{Area of } A'B'C' = \frac{1}{2} \frac{ca \cos \frac{B}{2}}{\sin \frac{C}{2} \cdot \sin \frac{A}{2}}$$

$$= \frac{1}{2} \sqrt{\left(\frac{s^2 (s-b) a^2 b^2 c^2}{s(s-b)(s-a)(s-b)(s-c)} \right)}$$

$$= \frac{abc}{\frac{2S}{s}} = \frac{abc}{2r}$$

But the radius of circle inscribed in A'B'C'

$$= \frac{\text{area of } A'B'C'}{\frac{1}{2}(A'B' + B'C' + C'A')}$$

$$= \frac{abc\, s}{S \left(a \operatorname{cosec} \frac{A}{2} + b \operatorname{cosec} \frac{B}{2} + c \operatorname{cosec} \frac{C}{2} \right)}$$

$$= \frac{abc\, s}{S \left(\sqrt{\frac{a^2 bc}{(s-b)(s-c)}} + \sqrt{\frac{b^2 ac}{(s-a)(s-c)}} + \sqrt{\frac{c^2 ab}{(s-a)(s-b)}} \right)}$$

$$= \frac{s}{\sqrt{\frac{s(s-a)}{bc}} + \sqrt{\frac{s(s-b)}{ac}} + \sqrt{\frac{s(s-c)}{ab}}} \text{ &c.}$$

24. The student is advised to draw a figure very carefully, and on a large scale.

Let ABC, and ABC' be the two triangles.

From A draw AG perpendicular to BC.

Let E be the middle point of AB.

Let D and D' be the middle points of BC and BC'; and F and F' those of AC and AC'.

Let H and H' be the middle points of EF and EF' and let HO, H'O' be drawn at right angles to EF'.

Let K and K' be the middle points of FD and F'D' and let KO and K'O' be drawn at right angles to FD, F'D'. Join FO', F'O' then the two triangles FKO and F'K'O' are equal in every respect.

∴ OF and OF' the radii of the two circles are equal.

But these circles would both pass through G (by the well known property of the nine point circle), and EG the common chord is = EB since E is the middle point of AB and AGB is a right angle. ∴ etc.

NOTE.—The Nine Point Circle will be fully discussed in the Solutions to Examples in next Chapter.

25. Let ABC be the triangle required and let the perpendiculars from A, B, C, contain x, y, z linear units.

$$\text{Sin } A = \frac{y}{c} = \frac{z}{b}$$

$$\therefore b : c = \frac{1}{y} : \frac{1}{z}$$

$$\text{similarly } c : a = \frac{1}{z} : \frac{1}{x}$$

If therefore we draw a triangle whose sides are as $\frac{1}{x} : \frac{1}{y} : \frac{1}{z}$ we draw a triangle equiangular to the required triangle.

Let APQ be this triangle and let AR be perpendicular to PQ from AR (produced if necessary) cut off AD = x.

Through D draw BDC parallel to PQ, and ABC is the triangle required.

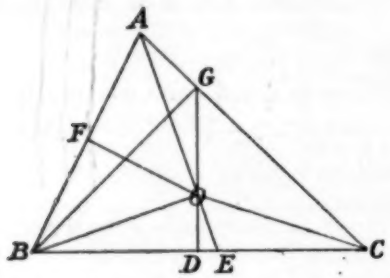
CHAPTER XXIII.

MISCELLANEOUS PROPOSITIONS.

294. In this Chapter, practically the last of these lessons, we purpose discussing one or two matters which will be found useful in solving problems. We also append a few remarks on the Geometrical interpretation, which has been assigned to the expression $\{\cos\theta + \sqrt{-1}\sin\theta\}\, r$.

295. If a problem concerning a triangle involve the ratios of the difference between two of its angles, we can prove geometrically certain relationships by means of the following figure. *e.g.* Prove that if AO, the radius of the circle, described about a triangle ABC, be produced to D,

$$AO : OE = \cos(B - C) : \cos A.$$



Let ABC be a triangle of which AC is greater than AB.

Let D and F be the middle points of BC and AB, and let DO, FO be at right angles to BC and AB, then O is the centre of the circle described about ABC, and $OA = OB = OC = R$.

Produce DO to meet AC in G, and join BG.

Then $GBC = GCB = C$ and $ABG = (B - C)$.

$AGB = GBC + BCG$ or $2C$, and $AOB = 2C$.

∴ (Converse of Eucl. iii., 21) a circle could be described about AGOB.

∴ AOG or $DOE = GBA = B - C$.

In the triangle OBE,

$$OE : OB \text{ or } OA = \sin OBD : \sin OEB$$
$$= \cos BOD : \cos DOE$$
$$= \cos A : \cos B - C.$$

296. A great number of expressions have been found for the area of a triangle. They can all be reduced to one of these three formulas, viz. :—

(i.) $\sqrt{s(s-a)(s-b)(s-c)}$

(ii.) $\frac{1}{2}ab\sin C$

(iii.) $\frac{b^2 \sin A \sin C}{2 \sin B}$.

297. In (i.) we have the area expressed in terms of the three sides, in (ii.) in terms of two sides and one angle, and in (iii.) in terms of one side and the angles.

298. Since, if we know two angles of a triangle we know the third, we can always find the area of a triangle if we know one side and two angles.

299. In 296 we might have said that all expressions for the area of a triangle could be reduced not only to one of three but to a single expression; for of the three expressions (iii.) can be reduced to (ii.) thus :—

if for $b \sin A$ we write $a \sin B$

and for $b \sin C$ we write $c \sin B$.

$\frac{b^2 \sin A \sin C}{2 \sin B}$ becomes $\frac{1}{2}ac \sin B$.

Similarly by writing $\frac{2}{bc}S$ for $\sin A$.

Formula (iii.) becomes S or formula (i.), and formula (ii.) can be got from (i.), or (i.) from (ii.)

300. Here is rather a complex expression for the area of a triangle, which we will reduce to formula (iii.)

viz. :— $\frac{a^2 - b^2}{2} \frac{\sin A \sin B}{\sin(A - B)}$.

$$\text{Since } \frac{a}{b} = \frac{\sin A}{\sin B}$$

$$\therefore \frac{a+b}{a} = \frac{\sin A + \sin B}{\sin A}$$

$$\text{and } \frac{a-b}{a} = \frac{\sin A - \sin B}{\sin A}$$

$$\therefore \frac{a^2 - b^2}{a^2} = \frac{(\sin A + \sin B)(\sin A - \sin B)}{\sin^2 A}$$

$$= \frac{2\sin\frac{A+B}{2}\cdot\cos\frac{A-B}{2}\cdot 2\cdot\sin\frac{A-B}{2}\cos\frac{A+B}{2}}{\sin^2 A}$$

$$= \frac{\sin(A+B)(\sin A - \sin B)}{\sin^2 A}$$

$$\therefore \frac{(a^2 - b^2)\sin A}{\sin(A-B)} = \frac{a^2 \sin C}{\sin A}$$

$$\frac{(a^2 - b^2)\sin A \sin B}{2\sin(A-B)} = \frac{a^2 \sin C \sin B}{2 \sin A}.$$

301. In problems which involve the perpendiculars from the angles on the opposite sides, we can often use with great advantage the fact that—

$$\text{area} = \tfrac{1}{2} \text{ perpendicular} \times \text{base}.$$

Let Δ represent the area of the triangle, and p_a, p_b, p_c the perpendiculars from A, B, C, on a, b, c respectively. Then we have $2\Delta = p_a a$; $2\Delta = p_b b$; $2\Delta = p_c c$.

$$\text{and } \Delta = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{but } s = \Delta\left(\frac{1}{p_a} + \frac{1}{p_b} + \frac{1}{p_c}\right)$$

$$\text{and } (s-a) = \Delta\left(\frac{1}{p_b} + \frac{1}{p_c} - \frac{1}{p_a}\right)$$

similarly with $(s-b)$ and $(s-c)$

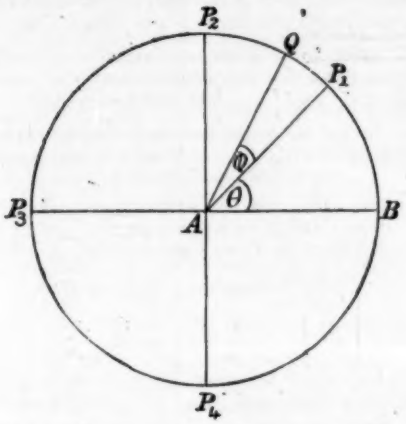
$$\therefore \Delta = \Delta^2 \sqrt{\left(\frac{1}{p_a} + \frac{1}{p_b} + \frac{1}{p_c}\right)\left(\frac{1}{p_b} + \frac{1}{p_c} - \frac{1}{p_a}\right)\left(\frac{1}{p_a} + \frac{1}{p_c} - \frac{1}{p_b}\right)\left(\frac{1}{p_a} + \frac{1}{p_b} - \frac{1}{p_c}\right)}$$

$$\therefore \frac{1}{\Delta} = \sqrt{\frac{p_b p_c + p_c p_a + p_a p_b}{p_a p_b p_c} \cdot \frac{p_c p_a + p_a p_b - p_b p_c}{p_a p_b p_c} \cdot \frac{p_a p_b + p_b p_c - p_c p_a}{p_a p_b p_c} \cdot \frac{p_b p_c + p_c p_a - p_a p_b}{p_a p_b p_c}}$$

$$\therefore \Delta = \frac{p_a^2 p_b^2 p_c^2}{\sqrt{(p_b p_c + p_c p_a + p_a p_b)(p_c p_a + p_a p_b - p_b p_c)(p_a p_b + p_b p_c - p_c p_a)(p_b p_c + p_c p_a - p_a p_b)}}$$

which expression is the area expressed in terms of the perpendiculars from the angular points to the opposite sides.

302.



Let AB be our initial line, and let it be represented by r, then AP_3 will be represented by $-r$, and whatever symbol represents AP_2, the same symbol with the opposite sign will represent AP_4.

Let P_1AB be an angle θ.

Let us see to what extent we may venture to assert that $\{\cos\theta + \sqrt{-1}\sin\theta\}\, r$ will represent the line AP_1 both in position and magnitude.

Let $\theta = \pi$

then $AP_2 = \{\cos\pi + \sqrt{-1}\sin\pi\}\, r$

$= -r$ as it ought to.

Again let $\theta = \frac{\pi}{2}$

then $AP_2 = \left\{\cos\frac{\pi}{2} + \sqrt{-1}\sin\frac{\pi}{2}\right\} r$

$= \left\{\sqrt{-1}\sin\frac{\pi}{2}\right\} r$

from which we could not by itself argue much, but if $\theta = \frac{3\pi}{2}$

$$AP_4 = \left\{\cos\frac{3\pi}{2} + \sqrt{-1}\sin\frac{3\pi}{2}\right\} r$$

$$= -\left\{\sqrt{-1}\sin\frac{3\pi}{2}\right\} r.$$

so that AP_4 is represented by the same symbol as AP_2 with a different sign.

303. Again, if with respect to AB, r AP_1 is represented in position and magnitude by

$\{\cos\theta + \sqrt{-1}\sin\theta\}\, r$

then if AP_1 be the initial line and QAP_1 contain ϕ angular units.

$\therefore AQ = \{\cos\phi + \sqrt{-1}\sin\phi\}$

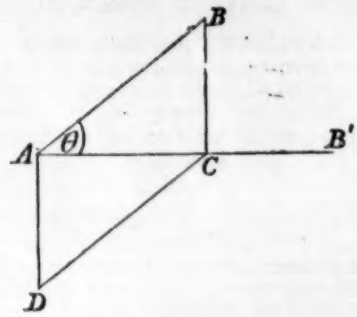
$\{\cos\theta + \sqrt{-1}\sin\theta\}\, r$

$= \{\cos(\phi+\theta) + \sqrt{-1}\sin(\theta+\phi)\}\, r$

as it ought to, by our supposition.

304. With this extension of the mode of expressing symbolically both the magnitude and the direction of straight lines, we can prove some interesting facts which are utilised in Higher Mathematics.

305. If $AB = r$ and $BAC = \theta$, $AC = r\cos\theta$ and $CB = r\sin\theta$ in magnitude.



If however we note these straight lines symbolically as to their position as well as to their magnitude, taking a line in the direction of AC as our initial line, we have

$AB = \{\cos\theta + \sqrt{-1}\sin\theta\}\, r$

$= r\cos\theta + \sqrt{-1}\, r\sin\theta$

But CB drawn at right angles to a line CB^1 equal to CB or $r\sin\theta$ is $\sqrt{-1}\,.\,CB^1$ or $\sqrt{-1}\, r\sin\theta$.

$\therefore AB = AC + CB.$

NOTE:—We must be careful to write AC not CA, and CB not BC.

CA would be noted by $-r\cos\theta$ and BC by $-\sqrt{-1}\sin\theta$.

306. Let AC contain a linear units, and CB, b such units.

$\therefore$ The length of AB is $\sqrt{a^2+b^2}$.

And symbolically

$$AB = \left\{\frac{a}{\sqrt{a^2+b^2}} + \sqrt{-1}\,\frac{b}{\sqrt{a^2+b^2}}\right\}\sqrt{a^2+b^2}$$

$= a + \sqrt{-1}\, b$

$= AC + CB.$

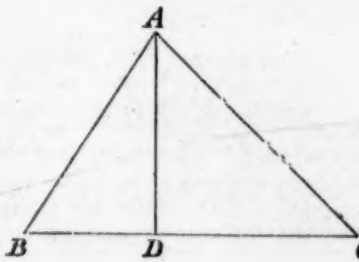
The expression then $a + \sqrt{-1}\, b$ represents a line $\sqrt{a^2+b^2}$ long inclined at an angle $\tan^{-1}\frac{b}{a}$ to the initial line.

307. If we complete the parallelogram ADCB, we have $AD = -\sqrt{-1}\, b$, and $DC = AB = a + b\sqrt{-1}$.

$\therefore AD + DC = -\sqrt{-1}\, b + a + b\sqrt{-1} = a$

$= AC.$

308. Let ABC be any triangle, and let AD be drawn perpendicular to the base.



Then symbolically

$$BA + AD = BD$$
$$\text{and } DA + AC = DC$$
$$\therefore BA + AD + DA + AC = BD + DC$$
$$\text{but } AD + DA = 0$$
$$\therefore BA + AC = BC$$
$$\text{and } BA + AC - BC = 0$$
$$\text{or } BA + AC + CB = 0.$$

Or the sum of the symbolical expressions of the sides of a triangle taken in order equals zero.

309. The same fact is true of the sum of the symbolical expressions of the sides of any polygon; which we leave the student to prove.

310. EXAMPLES XXIII.

1. If p_a, p_b, p_c are the three perpendiculars from A, B, C, respectively on the opposite sides, prove $\frac{p_a^2}{p_b\, p_c} = \frac{bc}{a^2}$.

2. If the sides of the triangle be in harmonic progression, *i.e.*, $\frac{1}{b} - \frac{1}{a} = \frac{1}{c} - \frac{1}{b}$; prove $\cos\frac{B}{2} = \sqrt{\frac{\sin A \sin C}{\cos A + \cos C}}$.

3. Let AB be the diameter of a circle and C its centre, take P_1, P_2, P_3, &c., so that $BCP_1 = P_1CP_2 = P_2CP_3 = $ &c., each $= \theta$.

If (radius = 1) $AP_1 = x + \frac{1}{x}$, $AP_n = x^n + \frac{1}{x^n}$.

4. Sum $\sec\theta \sec 2\theta + \sec 2\theta \sec 3\theta +$ &c., to n terms.

5. Sum $\operatorname{cosec}\theta + \operatorname{cosec} 2\theta + \operatorname{cosec} 4\theta +$ &c., to n terms.

6. Sum $\frac{1}{2}\tan\frac{1}{2}\theta + \frac{1}{4}\tan\frac{1}{4}\theta + \frac{1}{8}\tan\frac{1}{8}\theta +$ &c., to infinity.

7. If AB $(= r)$ and AD $(= r_1)$ be drawn making angles θ and θ^1 respectively with the initial line AE, complete parallelogram DABC and prove as in 306 that AC is represented symbolically by $\sqrt{r^2 + r_1^2 + 2rr_1\cos(\theta - \theta^1)}$ and is inclined to the line AE at an angle $\tan^{-1}\frac{r\sin\theta + r_1\sin\theta^1}{r\cos\theta + r_1\cos\theta^1}$.

8. Find the lengths of the perpendiculars from the angles on the opposite sides of the triangles, whose sides are 13, 14, and 15 inches respectively.

9. Prove that the area of any triangle is

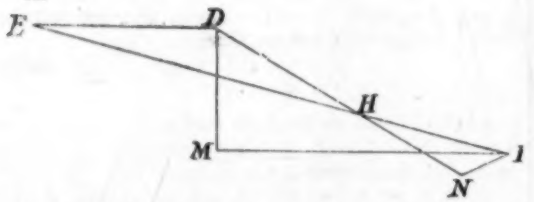
$$= \frac{2abc}{a+b+c}\cos\frac{A}{2}\cdot\cos\frac{B}{2}\cos\frac{C}{2}.$$

10. Show that in any triangle

$$\frac{1 + \cos(A - B)\cos C}{1 + \cos(A - C)\cos B} = \frac{a^2 + b^2}{a^2 + c^2}.$$

11. Find the area of the triangle if the perpendiculars on the three sides be 12, $\frac{15}{2}$, $\frac{5}{6}$ respectively.

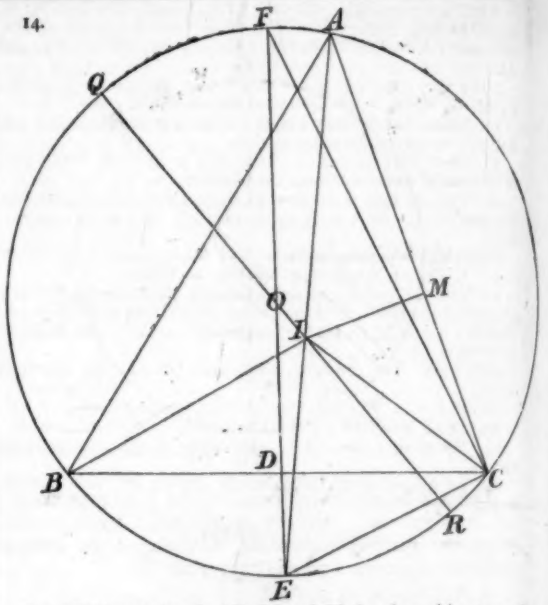
12.



If ED = DH and $EI^2 = 4\,DH \cdot DN$. Prove ND = N + IM.

13. In 12 produce HE to A′ so that EA′ = EI and draw A′M′ perpendicular to MD.
If $EA'^2 = 4\,DH \cdot DN$. Prove ND = NA′ − A′M′.

14.



Let ABC be a triangle AE, BI and CI the three bisectors of the angles A, B, C.
Let O be the centre of the circle described about ABC whose radius is R. Let IM = r (radius of inscribed circle).
By means of the above figure, prove

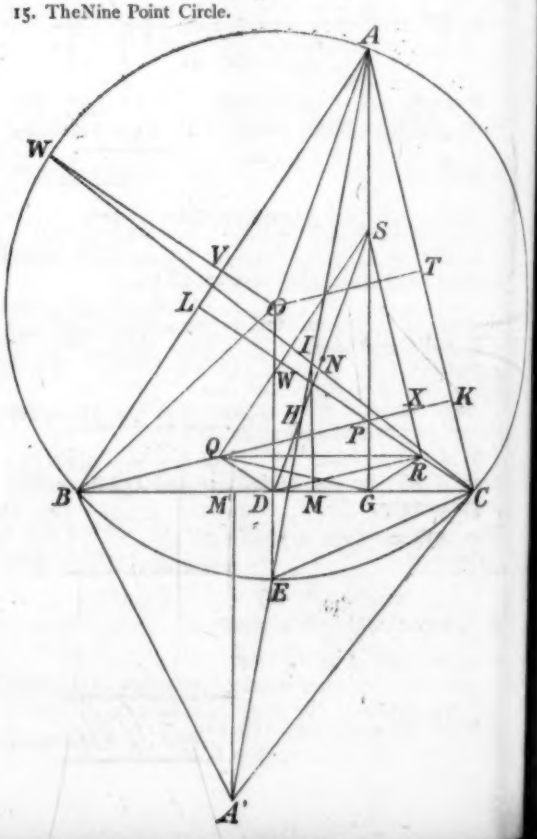
(i.) $EI = EC = 2R\sin\frac{A}{2}$.

(ii.) $IA = r\operatorname{cosec}\frac{A}{2}$.

(iii.) $(R - OI)(R + OI) = 2Rr$.

(iv.) $DE = 2R\sin^2\frac{A}{2}$.

15. TheNine Point Circle.



ABC is any triangle, AG, BK, CL perpendiculars from A, B, and C passing through P. Q, R, S the middle points of PB, PC, and PA and D, V, T, the middle points of CB, BA, and AC.

Show that a circle round SQR will pass through the six points L, M, G, K, T, V, thence called the nine point circle.

16. Show that the centre N of the nine point circle (see fig. Ex. 15), is the middle point of OP.

17. Show that the radius of the nine point circle is half that of the circle described about the triangle.

18. The student is advised to draw a very large figure like the one in 15, before working at this and succeeding propositions.

Prove DS is parallel to AO.

19. If DS cut EA in H, prove DE = DH.

20. Join CW, which bisects the angle ACB, cutting AE in I (centre of inscribed circle) and show that $EI^2 = 4DH \cdot DN$, *i.e.*, that the points E, D, H, N, I correspond to the points similarly lettered in Ex. 12.

21. Prove that the nine point circle touches the inscribed circle.

22. If EA′ = EI, A′ is the centre of escribed circle.

23. Prove $EA'^2 = 4\,DH \cdot DN$.

24. Prove that the nine point circle touches the escribed circles.

25. By means of Figure to Euclid IV. 10, find ratios of 18° and 36°.

(To be continued.)

—o—

Recent Inspection Questions.

Arithmetic.

STANDARD I.

1. Add 796, 87, 570, 976. 2,429. Ans.
2. From 724 take 319. 405. Ans.
3. 920 − 217. 703. Ans.

STANDARD II.

1. From 10,011 take 9,019. 992. Ans.
2. Multiply 90,690 × 809. 73,368,210. Ans.
3. 86,709 ÷ 9. $9,634\frac{3}{9}$. Ans.

STANDARD III.

1. Divide eight million nine hundred and seventy-six thousand and eighty-seven by 897.
$10,006\frac{705}{897}$. Ans.

2. Add £87,695 15s. 7¼d., £69 16s. 8¾d., £50,684 17s. 9½d., £750 18s. 10¾d., £70,895 19s. 11¾d., £869,706 16s. 11½d.
£1,079,804 5s. 11½d. Ans.

3. £3,024,036 3s. 2¼d. − £78,679 5s. 4½d.
£2,945,356 17s. 9¾d. Ans.

4. A house and furniture cost £5,760 16s. 7½d. The furniture cost £2,978 18s. 9¾d. What did the house cost?
£2,781 17s. 9½d. Ans.

STANDARD IV.

1. Multiply £17 18s. 0½d. by 93.
£1,664 15s. 11½d. Ans.

2. Divide £624,996 11s. 4½d. by 6,083.
£102 14s. 10¾d. Ans.

3. How many seconds from 8.55 a.m. to 12.30 p.m.?
12,900 secs. Ans.

4. Five boxes of fruit, each weighing 1 qr. 5 lb., cost £4 9s. 4½d. Find the price per lb.?
6½d. Ans.

STANDARD V.

1. If a man possessed $\frac{7}{8}$ of a ship and sold to each of three persons $\frac{1}{8}$, what share of the ship will the man now hold?
$\frac{7}{8} - \frac{3}{8} = \frac{4}{8} = \frac{1}{2}$. Ans.

2. Find the cost of 129 stones 7 lbs. 8 oz. at 1s. 2d. per stone.
£7 11s. 1½d. Ans.

3. If 48 suits can be made out of 168 yards of stuff, how many can be made out of 21 yards?
6 suits. Ans.

4. Make a bill for 5½ lbs. at 8½d. per lb.; 17½ @ 1s. 1½d., 56 @ ¼d., 128 lbs. @ £5 12s. per cwt., 30 lbs. at 3½d: per half lb.
(3s. 10¾d. + 19s. 8¼d. + 1s. 2d. + £6 8s. + 17s. 6d.)
= £8 10s. 3d. Ans.

STANDARD VI.

1. Take from *one* its fourth, fifth and sixth, and divide the result by $1\frac{1}{12}$ of $4\frac{3}{8}$.

$$[1 - (\tfrac{1}{4} + \tfrac{1}{5} + \tfrac{1}{6})] \div 1\tfrac{1}{12} \text{ of } 4\tfrac{3}{8}$$

$$\tfrac{60}{60} - \left(\frac{15 + 12 + 10}{60}\right) \div \tfrac{33}{60} = 1. \text{ Ans.}$$

2. Find the value of $\frac{3}{11}$ of £2 10s. 5d., and reduce the answer to the decimal of £34 7s. 6d.

$$\frac{\frac{3}{11} \text{ of £2 10s. 5d.}}{\text{£34 7s. 6d.}} = \tfrac{63}{2750} = .02. \text{ Ans.}$$

3. In what time will £450 make £81 interest @ 4½ per cent. per annum?

		Yrs.	Yrs.
£4½	: 81 ::	1	: 4. Ans.
£450	: 100		

4. If $\dot{6}$ of a cistern lasts $4\frac{3}{4}$ hours how long will $\frac{19}{21}$ last?

Hrs.		Hrs.
$\frac{2}{3}$: $\frac{19}{21}$ :: $4\frac{3}{4}$	:	$6\frac{25}{36}$. Ans.

STANDARD VII.

1. If £31½ pay 32 labourers for 12 days, how many labourers will £70⅛ pay for 16 days?

£31½	: 70⅛ ::	32	: 54. Ans.
Days 16		12	

2. At what rate per cent. will £315 amount to £378 in 5 yrs.?
£378 − £315 = £63.

£315	: 100 ::	£63	: £4. Ans.
Yrs. 5	:	1	

3. Out of 200 sheep ¼ are sold at 63s. each, ⅓ are sold at 62s. 6d. each, and the remainder at 61s. 6d. each, find the average price per head.
(63s. × 50 + 62s. 6d. × 40 + 61s. 6d. × 110)
÷ 200 = 12,415s. ÷ 200. = $62s.\ 0\frac{9}{10}d.$ Ans.

4. A grocer put on a bill £6 15s. instead of £6 5s. What per cent. did he cheat his customer?
125 : 100 :: 10s. : 8 per cent. Ans.

Notes of Lessons on Climate.

BY JOSEPH H. COWHAM, F.G.S.,

Lecturer on School Method: Westminster Training College.

PART I.

INFORMATION ARRANGED IN LOGICAL ORDER.	ILLUSTRATIONS AND TEACHING SUGGESTIONS.

Influence of Latitude upon the Climate of a district.

1. Varying height of the mid-day sun and corresponding changes in temperature.

(*a*) The sun when either rising or setting shines with far less heat effects than when it is high in the heavens at mid-day.

(*b*) The heat received from the sun at mid-summer, when it rises very high at mid-day, is much greater than in winter when it rises only one fourth as high.

(*c*) At the Equinoxes the sun is vertical at mid-day over the equator, and the heat is very great. As we proceed either northwards or southwards, the sun's rays become more slanting at mid-day the farther we go, and the heat becomes correspondingly less.

(*a*) and (*b*) Simple experiences which the class may be easily led to state.

The difference between the height of the sun at midsummer (62°) and the height attained at mid-day in winter (15°) should be illustrated by a diagram on the black board.

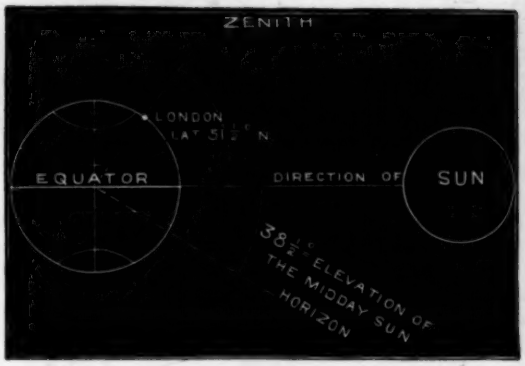


Fig. 1.

(*c*) Fig. 1 illustrates the varying elevations of the sun during the equinoxes at the Equator, at the Poles, and at London, viz.

1. **Vertical** at the Equator.
2. **On the Horizon** at the Poles.
3. 38½° at the latitude of London.

The reason for the changes of temperature are stated below.

2. Explanation of this increase in temperature.

(*a*) More heat reaches a given area under a vertical sun than reaches a similar area over which the rays fall in a slanting direction.

(*b*) The atmosphere absorbs less heat when the rays fall vertically upon it than when they fall obliquely; there is also less atmosphere in the former case through which the rays have to pass.

Fig. 2.

Fig. 2 represents the earth surrounded by its atmosphere.

AB and CD are similar areas on the earth's surface. The lesser width of the space between the two lines EF illustrates the lessened heat received on the surface at DC.

Fig. 2 shows also the increased amount of atmosphere the oblique rays E and F must pass through before reaching the earth's surface.

3. Changes of temperature due to the varying lengths of day and night.

Changes familiar to the class:—

(*a*) In the summer the days are much longer than the nights in our latitude and **when the days are long the heat is great.**

(*b*) In winter our days are much shorter than our nights, **and the heat is greatly diminished.**

(*a* and *b*) The changes of temperature which accompany our different lengths of the day are well known and may be stated by the class.

The following diagram will help the children to understand the reason of the changes in the length of day and night in other latitudes both as compared with ours at any given season, and as compared with their own at different seasons.

WINTER SOLSTICE. SUMMER SOLSTICE.

Fig. 3. The earth is represented as revolving one half towards the sun, and hence in the light, the other half in a cone of shade.

Changes in varying latitudes:—

(*a*) The days and nights are always of equal length at the Equator.

(*b*) In the Northern Hemisphere the days become longer in the summer as the latitude increases until round the North Pole the sun does not set for many months together.

(*c*) During our winter on the contrary the days become shorter as the latitude increases. At the North Pole during this season the sun never rises.

Fig. 3 illustrates also—
(1) Varying length of day at different latitudes at the winter or the summer solstice.
(2) Varying length of the days in any given latitude at the two solstices.

(*a*) The Equator in both cases (Fig. 3) is seen to be half in the light and half in the shade. It may further be stated that both the equator and the circle of illumination, I L, bisect each other, in consequence of being '*great circles*.'

(*b*) If a black paper cylinder be placed round the half of the earth away from the sun, as in Fig. 3, the effects stated in (*b*) and (*c*) will be readily seen.

Models should be made as illustrated in Fig. 3. In this way only can the varying lengths of the day be readily and thoroughly grasped by the class.

Combined effect of a long day and of either a vertical or very high sun.

1. The heat received from the sun throughout the entire year is greatest near the equator because there **the sun is always near the vertical position.**

2. The heat is, however, greater still near the Tropics at the Solstices because at this season the sun shines vertically and the day is longer than it ever is at the equator.

1. By the aid of a diagram similar to Fig. 1 it may be shown how far the sun moves from the vertical position at the Equator at mid-day during the year, viz., 23½° to the north at our mid-summer, and 23½° to the south of the equator at our mid-winter season.

2. If the lighted portion of the Tropic of Cancer at the summer solstice (Fig. 3) be examined it will be found to be greater than the portion in the shade by twice the distance *a b*. **Hence the greater heat.**

If a position C (Fig. 3) near the latitude of London be observed whilst the globe is rotating it will be seen to be twice as long in the light during the summer solstice as it is during the winter solstice.

3. Whilst it is colder as we leave the tropics and approach higher latitudes, **the change from the heat of summer to the cold of winter is greater the further we travel from the Equator.**

Contrast of changes near the Poles with those in Temperate regions.

These changes are greatest in Polar regions as shown by the complete change in Polar condition of light and heat (Fig. 3).

In the latitude of England and the greater portion of Europe the changes are not so marked, and for this reason we are said to have a '*Temperate climate.*'

BLACKBOARD SKETCH.

1. The sun's heat is felt to be greatest when it is highest in the heavens.
2. The sun shines vertically near the Equator, and obliquely in temperate and Polar regions.
3. The heat from the sun is greatest where it shines vertically for two reasons:
   (*a*) Because more heat is imparted.
   (*b*) There is less atmosphere to intercept it.
4. Days vary in length according to the season and the latitude.
5. (*a*) Most heat is received during the year near the Equator.
   (*b*) The highest temperature is reached near the Tropic of Cancer at the summer solstice.
   (*c*) In high latitudes the difference between winter and summer heat is great and it increases with the latitude.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

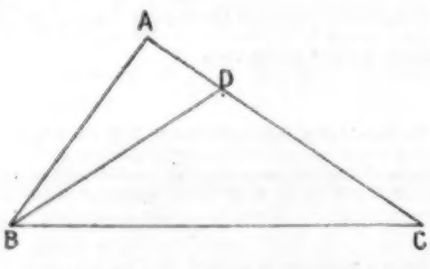
5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor,*' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

Geometry.

1. MORAY HOUSE.—Give a direct proof of Euclid I. 19. (*Casey's* 'Sequel to Euclid.')



As the angle ABC is greater than the angle BCA, at the point B make the angle CBD equal to the angle BCA (I. 23), and let BD cut AC in D.

Proof.—$\angle DCB = \angle DBC$, (Con.)

$\therefore$ Side DC = side DB; (I. 6)

Wherefore AD and DC, that is, AC = AD and DB, (Ax. 2.)

But AD, DB are greater than AB, (I. 20.)

$\therefore$ AC is greater than AB.

Q. E. D.

Arithmetic.

1. CRUX.—Determine at what rate per cent. £3,750 will increase to £4,341 1s. 10½d. in 3 years, (1) at Simple Interest (2) at Compound Interest, it being given that in this latter case the ratio of the amount to the principal is the cube of the ratio of the amount of £1 at the same rate in one year to £1.

(*College of Preceptors*, Christmas, 1886.)

(1) *Simple Interest.*

£ s. d.
4341 1 10½
3750
£3 | 591 1 10½
£3750 : £100 :: 197 0 7½ : Rate %
75 2 2
75)394 1 3(5£
375
19
20
75)381(5s.
375
6
12
75)75(1d.
75

$\therefore$ Rate per cent. = £5 5s. 1d.
or $5\frac{21}{25}$. Ans.

(2) *Compound Interest.*

Amount of £1 in 3 years

$$= £4,341\ 1\ 10\tfrac{1}{2} \div 3,750$$
$$= £4,341{\cdot}09375 \div 3,750$$

£ £

$= 3750)4341{\cdot}09375(1{\cdot}157625$

375
591
375
2160
1875
2859
2625
2343
2250
937
750
1875
1875

Amount of £1 in one year

$$= \sqrt[3]{1{\cdot}157625} \text{ of } £1$$
$$= 1{\cdot}157625(1{\cdot}05$$

1

$10^2 \times 300 = 30000 \mid 157625$
$10 \times 5 \times 30 = 1500$
$5^2 = 25$
$31525 \mid 157625$

$= £1{\cdot}05$;

Amount of £100 in one year $= £105$;

$\therefore$ Rate per cent. $= \underline{5}$. Ans.

2. STUDENT.—A proprietor of 3 per cent. stock receives his half-yearly dividend, and lays it out in the purchase of more stock at 90. His next half year's dividend is £457 10s.; how much does this dividend exceed the former? (*Brook-Smith.*)

Half-yearly dividend on each £100 stock

$$= \tfrac{1}{2} \text{ of } £3$$
$$= £1\ 10s.;$$

Next half-yearly dividend on each £100 stock after investing former dividend

$$= £1\ 10s. + \tfrac{1}{2} \text{ of } \frac{3}{90} \text{ of } £1\ 10s.$$
$$= £1\ 10s. + \tfrac{1}{30} \text{ of } 30s.$$
$$= £1\ 10s.\ 6d.;$$

£ s. d. £ s. d.

$\therefore$ 1 10 6 : 457 10 :: 6 : Increase of dividend.

20
30
2 £ s.
61)457 10(7£
427
30
20
610(10s.
610

$\therefore$ Increase of dividend = £7 10s. Ans.

3. DEVA.—A farmer plants one acre of turnips. The rows are 26 inches apart, and the turnips in each row 12 inches apart. What weight of turnips are grown supposing 4 turnips weigh a stone?

How many turnips can be grown on a square yard, supposing the rows and distance between the turnips be made equal?

Let us take the land as measuring 121 yds. by 40 yds.;

$$\therefore \text{Number of rows} = \frac{121 \times 3 \times 12}{26} - 1$$
$$= \frac{2178}{13} - 1$$
$$= 167 - 1$$
$$= 166;$$

Number of turnips in a row $= (40 \times 3) - 1$
$= 119$;

$\therefore$ Number of turnips for an acre $= 166 \times 119$;

$$\therefore \text{Weight} = \frac{166 \times 119}{4} \text{ stone}$$
$$= \frac{19754}{2} \text{ stone}$$
$$= 9877 \text{ stone}$$
$$= 617 \text{ cwt. } 2\tfrac{1}{2} \text{ stone}$$
$$= 30 \text{ tons } 17 \text{ cwt. } 2\tfrac{1}{2} \text{ stone.}$$

For a square yard let us take 1 yd. by 1 yd., and distance between rows and between turnips 12 in.

Then, number of turnips for a sq. yard.

$$= (3 - 1) \times (3 - 1)$$
$$= 2 \times 2$$
$$= \underline{4}.$$

4. CYCLOPS.—If two boats, A and B, row in a race at their usual speed, A will win by 80 yards; but the day proving unfavourable, A can only row at $\frac{8}{9}$ of its usual speed, while B rows at $\frac{9}{10}$ of its usual speed. A wins by 20 yards. Find the length of the course.

(1) A's rate : B's rate :: length of course : length of course − 80 yds.;

And (2) $\frac{8}{9}$ A's rate : $\frac{9}{10}$ B's rate :: length of course : length of course − 20 yds.;

$$\therefore (1)\ \frac{\text{A's rate}}{\text{B's rate}} = \frac{\text{course}}{\text{course} - 80 \text{ yds.}};$$

$$\text{and } (2)\ \frac{80 \text{ times A's rate}}{81 \text{ times B's rate}} = \frac{\text{course}}{\text{course} - 20 \text{ yds.}},$$

$$\frac{\text{A's rate}}{\text{B's rate}} = \frac{\text{course}}{\text{course} - 20 \text{ yds.}} \times \tfrac{81}{80};$$

$$\therefore \frac{\text{course}}{\text{course} - 80 \text{ yds.}} = \frac{\text{course}}{\text{course} - 20 \text{ yds.}} \times \tfrac{81}{80},$$

$$\frac{1}{\text{course} - 80 \text{ yds.}} = \frac{1}{\text{course} - 20 \text{ yds.}} \times \tfrac{81}{80},$$

81 times (course − 80 yards) = 80 times (course − 20 yds.),

81 times course − 6,480 yds. = 80 times course − 1,600 yds.,

81 times course − 80 times course = 6,480 yds. − 1,600 yds.,

$\therefore$ Length of course = 4,880 yds.

$= \underline{2 \text{ miles } 1,360 \text{ yds.}}$ Ans.

5. HOPEFUL.—The dividends on the three per cent. consols are paid on January 5th and July 5th; the dividends on the New 3 per cents. are paid on April 5th and October 5th. What money must a person, who already holds £1,500 of the former stock and £2,500 of the latter, invest to secure an income of £400 a year being paid quarterly, consols being at 93 and New 3 per cents. at $91\frac{1}{2}$?

Income from each stock must be £200;

,, consols = 3 % on £1,500
= £45;

,, New 3 per cents. = 3 % on £2,500
= £75;

$\therefore$ Income required from consols = £200 − £45
= £155;

,, ,, ,, New 3 per cents = £200 − £75
= £125;

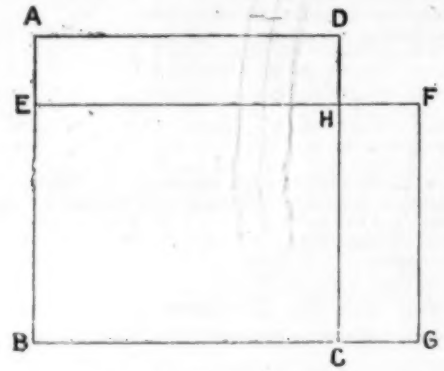
$\therefore$ Amount in consols = £155 × $\frac{93}{5}$
= £155 × 31
= £4,805;

,, New 3 per cents. = £125 × $\frac{91\frac{1}{2}}{3}$
= £125 × $\frac{183}{6}$
= £125 × $\frac{61}{2}$
= £3,812 10s.;

$\therefore$ Amount to be invested = £4,805 + £3,812 10s.
= £8,617 10s. Ans.

Mensuration.

1. NID.—A rectangle is ·202 of an inch longer than a certain square, and ·2 of an inch narrower; but contains the same area: show by a figure that the number of inches in the side of the square is the product of ·202 into ·2, divided by their difference: and if, in measuring the edges of a cubical box to ascertain its content, an error of ·202 of an inch is made in excess for the length, and of ·2 of an inch in defect for the breadth, the height being properly measured, the calculated volume agrees with the true volume, find the volume in cubic inches.



If area of square ABCD = area of rectangle EBGF,

Then, area of rectangle HCGF = area of rectangle AEHD;

$\therefore$ HC × CG = AD × AE,

(Side of square − ·2) × ·202 = side of square × ·2,

Side × ·202 − (·2 × ·202) = side × ·2,

Side × (·202 − ·2) = ·202 × ·2;

$\therefore$ Side of square in inches = product of ·202 into ·2, divided by their difference

= ·0404 ÷ ·002

= 20·2.

$\therefore$ Volume of cubical box = (20·2 in.)³

= (20·2 × 20·2 × 20·2) cub. in.

= (408·04 × 20·2) cub. in.

= 8,242·408 cub. in. Ans.

Algebra.

1. DUFFER.—How many words of two consonants and one vowel can be formed from 6 consonants and 3 vowels, the vowel being the middle letter of each word? (*Todhunter.*)

No. of *permutations* of 6 consonants two at a time = 6 . 5

= 30;

Then, if a vowel be placed in the middle of each permutation,

No. of words = 30 × 3

= 90. Ans.

2. GENOA.—The pth, qth, and rth terms of an A. P. are x, y, z respectively; prove that if x. y, z be positive integers, there is an A. P. whose xth, yth, and zth terms are p, q, r, respectively; and that the product of the common differences of the progressions is unity.

If a represent the first term, and d the common difference

$$\left.\begin{array}{l}(1)\ x = a + (p-1)\,d \\ (2)\ y = a + (q-1)\,d \\ (3)\ z = a + (r-1)\,d\end{array}\right\}$$

From (1) $p - 1 = -\frac{a}{d} + \frac{x}{d}$

$= \frac{1-a}{d} + \frac{x-1}{d}$ { Adding and Subtracting $\frac{1}{d}$

$$\left.\begin{array}{l}\therefore p = 1 + \frac{1-a}{d} + (x-1)\frac{1}{d} \\ \text{From (2)}\ q = 1 + \frac{1-a}{d} + (y-1)\frac{1}{d} \\ \text{,, (3)}\ r = 1 + \frac{1-a}{d} + (z-1)\frac{1}{d}\end{array}\right\}$$

These show that p, q, r, are respectively the xth, yth, zth terms of an A. P., of which the first term is $1 + \frac{1-a}{d}$, and the common difference is $\frac{1}{d}$.

Product of the common differences = $d \times \frac{1}{d}$ = unity.

General.

1. VERITAS.—Your query is an absurdity, as it is impossible to multiply money by money.

2. MECHANIC.—Look up the rules of the mensuration of triangles and parallelograms.

From a square a portion is cut off by a line passing through two adjacent sides. Find the centre of gravity of the remainder. Let the square be ABCD. Let E be the middle point of AB, and F the middle point of BC, join EF. Then the area EBF is plainly $\frac{1}{8}$ of the square. $\therefore$ the remainder AEFC is seven eighths of the square. Join BD and let it cut EF in G. Bisect BD in O. Now the centre of gravity of the triangle EBF is in the line BG at H, a distance of $\frac{2}{3}$ of BG from B, the centre of gravity of the square is at O, and let the centre of gravity of the remainder be at a distance x from B in the line BD. We must now find the length BG. Let BA = 1; then BE = $\frac{1}{2}$, then EF = $\frac{\sqrt{2}}{2}$, and EG = $\frac{\sqrt{2}}{4}$, and BG = $\sqrt{\text{EB}^2 - \text{EG}^2} = \sqrt{\frac{1}{4} - \frac{1}{16}} = \sqrt{\frac{3}{16}} = \frac{1}{4}\sqrt{3}$ and BH = $\frac{2}{3} \times \frac{1}{4}\sqrt{3} = \frac{1}{6}\sqrt{3}$: and GH =

Taking moments about B

$$\tfrac{1}{6}\sqrt{3} \times \tfrac{1}{8} + x \times \tfrac{7}{8} = 1 \times \tfrac{1}{2}\sqrt{2}$$

$$\therefore \tfrac{7}{8}x = \sqrt{2}\left(\tfrac{1}{2} - \tfrac{\sqrt{3}}{16}\right)$$

$$= \sqrt{2}\left(\tfrac{8-\sqrt{3}}{16}\right)$$

$$\therefore x = \tfrac{8-\sqrt{3}}{14} \times \tfrac{8}{7}\sqrt{2}$$

$$= \tfrac{8-\sqrt{3}}{14}\sqrt{2} \text{ from B.}$$

3. PRACTICAL TEACHER.—

A. Adverbial sentence of condition—

Half the power	subject.
were given	predicate.
to redeem the human mind from error	extension of purpose.

B. Adjective sentence to (A) qualifying 'power'—

that	subject.
fills	predicate.
the world	object.
with terror	indirect object.

C. Adverbial sentence of condition to (D)—

Half the wealth bestowed on camps and courts	subject.
were given	predicate.
to redeem the human mind from error	extension of purpose.

D. Principal sentence—

There	introductory particle.
no need of arsenals nor forts	subject.
were	predicate.

4. DARWEN.—

Principal Sentence A	So sorrow's heaviness	subject.
	doth grow heavy	predicate
	for debt.	ad. exten. of reason.
Adjective Sentence B to A	Bankrupt sleep	subject.
	doth owe	predicate
	that	direct object
	(to) sorrow.	indirect object.

5. A CONSTANT READER.—Select the college you would like to enter and then write to the secretary of it who will most readily give you all the information you want.

6. NONYEB.—You would appear to have answered three questions out of four. That is a good proportion, and if they were well done you ought to be high up on the list. But as you must see much depends upon the answers themselves, and of them we have no means of judging.

7. NELLIE.—We cannot pretend to select the best books, and very often opinions differ as to what are the best. The Geography you name contains much useful matter, but you must now add another. To get an idea of how ideas upon that subject have changed, buy and read Geikie's 'Introduction to the Study of Geography (Macmillan). Read Murray's 'Historical English Grammar,' 2s. 6d. If you live in the country you might study Botany. Use Oliver's 4s. 6d. Manual, and Bettany's 1s. 'Practical Botany.'

8. H. M.—Read the Syllabus, especially the remarks at the end as to how the subject should be taught. You must work as well as read. You will find all you want to know in Thomé's 'Botany' (Longman and Co.). 'First Lessons in Practical Botany,' by Bettany, would be useful as you are beginning the subject. The 'Penny Cyclopædia' can be best obtained secondhand at almost any of the secondhand book shops. The contents of the next volume have not been settled yet. The subjects of the Syllabus are of course not likely to be lost sight of.

9. HANDWRITING.—The large hand 60; small hand 75. The letters of the large hand are generally faulty; the chief faults are in the flat curves and abrupt joinings. The long strokes, too, are ragged. The small hand promises much better. You should remember that the same letter should always have the same form in the same copy, the letter h in three successive words has three different shapes. Uniformity is essential.

10. L'ESPERANCE.—School Management, National Society's Manual; Physical Geography, Lawson's; Lock's Trigonometry for beginners; Geometry, Chamber's Euclid, or Todhunter's; Perspective, Yule's; Dalton's examples in Arithmetic. For the French use the French Principia, part II., which has a good vocabulary also.

11. JACK.—We don't know that there is any such book as you desire yet published.

12. ERIN.—The question is really so much a matter of taste that we cannot make a selection. The topics for criticism might relate to language, and knowledge of character.

13. WRITING.—The large hand of the word 'Physiographically' is well written, but it is too large. The small hand is heavy, it lacks neatness and elegance, 75, 70.

14. A. PARSONS.—Were is used with given and is equivalent to, '*if half the wealth were given.*' Its syntax is therefore quite easy. Bestowed, is a past participle and is used as an adjective qualifying 'wealth.'

15. LEX.—We do not know of an edition which unites all the features you mention. We will make further enquiries during the month.

16. AEGEUS.—It is a matter of opinion. Everett's edition of *Deschanel* (Blackie) is an excellent book, cheap and well illustrated. *Garnett's* 'Heat' is very good (Bell and Co.)

17. SCOTCH CODE.—*Darnell's* 'English Language,' *B. Smith* or *Lock's* 'Arithmetic,' *Lawson's* 'Geography,' 'History' *Hume's* or *Green's*, Teaching, National Society's Manual, Latin, *Roby's* 'Smaller Latin Grammar,' *Bradley's* 'Latin Composition.'

18. S. J. P. A.—Large hand irregular and ill shaped, 60. Small hand better, 75.

19. TAU.—There is no good German English Dictionary with the derivation and pronunciation such as you want. *Flügel's* dictionary is the best, use the German Edition.

20. NORTHUMBRIA.—Any of the four copies of the civil service hand will do very well. No. IV. seems the best, 80.

21. R. G. T.—Don't use any more. But if you will try another buy *Locke's* new volume.

22. SHERWOOD.—Next month.

Publications Received.

Bemrose and Sons—

The Jubilee Arithmetics. Standards 1 to 7, with Answers.

Blackie and Son—

Stories of Old Renown. By Ascott R. Hope.
The Bubbling Tea-pot. By L. W. Champney.
Our General. By E. J. Lysaght.
Aboard the Atalanta. By Henry Frith.
The History of Gutta Percha Willie. By George Macdonald.
Girl Neighbours. By Sarah Tytler.
For the Temple. By G. A. Henty.
Orange and Green. By G. A. Henty.
Bonnie Prince Charlie. By G. A. Henty.
Chivalric Days. By E. S. Brooks.
The War of the Axe. By Percy I. Groves.
Miss Willowburn's Offer. By Sarah Doudney.
Chirp and Chatter. By Alice Banks.
Aunt Hesba's Charge. By Elizabeth J. Lysaght.
Hop o' my Thumb.
Beauty and the Beast.
Sonntag's French Grammar. Part II.

Cassell and Co., Limited—

Cassell's Attendance Register.

Deacon, G. W., and Co.—

A Sketch of Geological History. By E. Hull, M.A.

Heywood, John—

Sound, Light, and Heat. Part I. By Alfonzo Gardiner.
Local Examination History. By Dr. Pringle.
Every Man his own Art Critic. By Patrick Geddes.

Hodder and Stoughton—

Sukie's Boy. By Sarah Tytler.
Barbara. By Clara Vance.
Harry Milvaine. By Gordon Stables, M.D.
The British Weekly Extras. No. 1.
Unfinished Worlds. By S. H. Parkes, F.R.A.S.

Longmans and Co.—

Longmans' "Rule" Arithmetical Test Cards. Standards 3, 4, 5, 6 and 7.
Civil Service Arithmetic. By R. Johnstone.

Miscellaneous—

The Madras Journal of Education. September.

Murby, Thomas—

Notes on the Early Church. By the Rev. R. O. Thomas.

Nelson and Sons—

The Royal Upper Class Readers. No. 1.

Philip, G., and Son—

Modern Gymnastic Exercises. Part I. By A. Alexander.

Smith, Elder and Co.—

The Cornhill Magazine. October.

Swan Sonnenschein and Co.—

Health Maps. Groups 1 to 5.

The Clarendon Press—

Johnson: History of Rasselas. By G. Birkbeck Hill, D.C.L.
Selections from the Book of Genesis. By the Rev. H. M. Clifford, M.A.
The Apology of Plato. By St. George Stock, M.A. Part I., Text. Part II., Notes.

The Educational Supply Association—

Geographical Reader. No. 6. By W. Lawson.
Oxford, Cambridge, and College of Preceptors' Examination Papers.
Post Office Tots and Cross Tots.
French, Latin, and English Parsing Books.

The National Society's Depository—

Under the Storm. By Charlotte M. Yonge.
For Half a Crown. By Esmé Stuart.
Uncle Ivan. By M. Bramston.
A Promise Kept. By M. E. Palgrave.
Prentice Hugh. By F. M. Peard.

Trübner and Co.—

A Note on Indo-European Phonology. By D. Beatson Murdoch.

Whittaker and Co.—

Moser: Der Bibliothekar. By Prof. F. Lange.
Progressive German Examination Course. Elementary. By Prof. F. Lange.

The 'Practical Teacher' Sale and Exchange Column.

What Offers?—Vols. IV., V., VI. of THE PRACTICAL TEACHER; splendid condition.—C. A. Stanyer, New Gate-street, Chester.

For Sale.—Colenso's Algebra (4s. 6d.), for 2s.; 'Paradise Lost,' Books I. and II. (new), with Notes by Mason, and 'Life of Milton' (2s. each), for 1s. each; Dr. Bullock's Student's Eng. Gram. (1s. 6d.), for 9d.; Collier's History (2s. 6d.), for 1s. 3d.—G. I. Y., 2, Helena-avenue, Margate.

For Sale.—'Popular Educator,' 2 vols., bound, 10s.; 'Paws and Claws,' 2s. 6d.; Stewart's 'Guide to Matriculation,' 1s.; 'Varied Occupations,' 1s. 3d.; Lawson's Geography, 1s. 9d.; Stewart's 'Physics,' 2s. 3d.; Huxley's 'Physiology,' 2s. 3d.; Beeton's 'Household Management,' 3s. 9d.; 'Manners of 'Polite Society, 1s.; Currie's 'Infant Education,' 2s.; Moffat's 'How to Teach Arithmetic,' 1s. 3d., Rick's 'Object Lessons,' 1s. 9d.; Collier's 'British History,' 1s. 3d.; Hassell's 'Domestic Economy,' 6d.; Cassell's Magazine,' 1885 and 1886, unbound, 3s. 6d. each; 'Sybil,' 6d.; 'Lothair,' 6d.; 'Westward Ho,' 3s.—Apply M. E. Taylor, 39, Longcauseway, Farnworth, Bolton.

Pupil Teachers' Examination.

OCTOBER 15th, 1887.

END OF FIRST YEAR.

Arithmetic.

(Do three sums only.)

MALES.

1. (*a*) Define a proper fraction; a compound fraction; a recurring decimal.

(*b*) Find the value of $\frac{3\frac{1}{2} + 4\frac{1}{2} + 9 - 2\frac{3}{4}}{1\frac{1}{2} \text{ of } 3\frac{1}{2} - \frac{1}{2}}$.

(*a*) A proper fraction is one in which the numerator is less than a denominator, as $\frac{3}{4}$.

A compound fraction is a fraction of a fraction, as $\frac{1}{2}$ of $\frac{3}{4}$.

A recurring decimal is one in which the division will not terminate but in which the same figures will be repeated over and over again.

(*b*) $\frac{3\frac{1}{2} + 4\frac{1}{2} + 9 - 2\frac{3}{4}}{1\frac{1}{2} \text{ of } 3\frac{1}{2} - \frac{1}{2}}$

$= \frac{3\frac{1}{2} + \frac{1}{2} - 2\frac{3}{4}}{\frac{11}{2} - \frac{1}{2}}$

$= \frac{1}{\frac{10}{2}}$

$= \frac{1}{5}$. Ans.

2. Find the value of $\frac{3}{5}(1 - \frac{1}{6})$ of a guinea $+ (\frac{7}{8} - \cdot 7)$ of £2 5s. $+$ ·23 of £1 10s., and express the result as a decimal of £1.

$\frac{3}{5}(1 - \frac{1}{6}) \frac{21}{1} + (\frac{7}{8} - \frac{7}{10}) \frac{40}{1} + \frac{23 - 2}{90} \times \frac{20}{1}$

$= \frac{3}{5} \times \frac{5}{6} \times \frac{21}{1} + \frac{7}{80} \times \frac{40}{1} + \frac{21}{90} \times \frac{20}{1}$

$=$ 7s. $+$ 3s. 6d. $+$ 7s.

$=$ 17s. 6d. Ans.

$\frac{17\text{s. } 6\text{d.}}{20\text{s.}} = \frac{7}{8} =$ ·875 Ans.

3. A workman spends $\frac{7}{8}$ of his weekly wage in keeping himself and family. He puts $\frac{1}{8}$ of what is left in the savings bank, and he still has 6d. left. What weekly wages does he earn?

$1 - \frac{7}{8} = \frac{1}{8}$ left after keeping family

$\frac{1}{8} - (\frac{1}{8} \text{ of } \frac{1}{8}) = \frac{1}{8} \text{ of } \frac{7}{8} = \frac{7}{64}$ left after keeping and saving

$\frac{7}{64} =$ 6d.

$\therefore \frac{64}{64} =$ 32s. his weekly wages. Ans.

4. State the rule for finding a vulgar fraction which is equivalent to a mixed recurring decimal, and show that the rule holds true in bringing ·3098 to a vulgar fraction.

Rule.—For the numerator write down all the figures to the end of the first period, subtracting the figures which do not circulate.

For the denominator write down as many 9's as there are circulators, followed by as many o's as there are non-circulators in the fraction.

$$\cdot 3098 = \frac{3098 - 30}{9900} = \frac{3068}{9900} = \cdot 3098$$

FEMALES.

1. Make out in proper form and receipt the following account:—5 gals. of strawberries at 5½d. per qt.; 3 score lbs. of potatoes at 5 lbs. for 3½d.; 2¼ lbs. of tomatoes at 11d. per lb.; 2¾ pks. of peas at 1s. 5d. per pk.; 75 eggs at 9d. per doz.

London,
15th October, 1887.

Mrs. Jones.

Bought of Wm. Robinson.

	£	s.	d.
5 gals. of strawberries at 5½d. per qt.	0	9	2
3 score lbs. of potatoes at 5 lbs for 3½d.	0	3	6
2¼ lbs. of tomatoes at 11d. per lb.	0	2	0¾
2¾ pks. of peas at 1s. 5d. per pk.	0	3	10½
75 eggs at 9d. per doz.	0	4	8¼
	1	3	3¾

Received same time,
Wm. Robinson.

2. Find by Practice the value of 75 tons 9 cwt. 92 lbs. of coal at £1 3s. 4d. per ton.

	£	s.	d.		
5 cwt. = ¼ ton	1	3	4	= cost of 1 ton.	
		75			
	87	10	0	= ,,	75 tons.
4 cwt. = ⅓ ton	0	5	10	= ,,	5 cwt.
56 lbs. = ¼ 4 cwt.	0	4	8	= ,,	4 ,,
28 lbs. = ½ of 56 lbs.	0	0	7	= ,,	56 lbs.
8 lbs. = ¼ of 56 lbs.	0	0	3½	= ,,	28 ,,
	0	0	1	= ,,	8 ,,
	£88	1	5½	= ,,	75 tons 9 cwt. 92 lbs.

3. How would you explain to beginners in fractions that $\frac{3}{4} = \frac{9}{12}$? Express $\frac{891}{1287}$ as a fraction in its lowest terms, and $\frac{7}{13}$ as a fraction with denominator 1496. Give a full explanation of each process.

I should draw a line on the blackboard and divide it into 3 equal parts. Each of these I should again divide into three equal parts. I should then show that two of the larger parts or ⅔ of the line were the same as six of the smaller parts or ⅔ of the line.

As a second illustration I should use 9 coppers, or balls, or counters and repeat the process.

$$\frac{861}{1393} = \frac{123 \times 7}{123 \times 11} = \frac{7}{11}.$$

From previous lessons in fractions the class would have been shown that numbers are made up of factors, and that *multiplying the numerator and denominator of a fraction by the same number does not alter its value.* This fraction is made up of 123×7 and 123×11. Take away the common factor and $\frac{7}{11}$ remains, without any other common factor it is thus in it lowest terms.

$$\frac{13}{17} = \frac{13}{17} \times \frac{88}{88} = \frac{1144}{1496}.$$

This is the reverse process of the former example. To make 17 into 1496 we must multiply by 88. So as not to alter the value of the fraction, we must then multiply the numerator by the same number.

4. A, B, C, and D can do respectively $\frac{1}{12}$, $\frac{19}{120}$, $\frac{33}{200}$, and $\frac{33}{175}$ of a piece of work in a day; how much could A and D working together for a day do less than B and C working together for a day.

$$(\tfrac{19}{120} + \tfrac{33}{200}) - (\tfrac{1}{12} + \tfrac{33}{175})$$
$$= \frac{80 + 75}{228} - \frac{65 + 64}{190}$$
$$= \tfrac{155}{456} - \tfrac{129}{190}$$
$$= \frac{775 - 774}{1140}$$
$$= \tfrac{1}{1140}. \text{ Ans.}$$

END OF SECOND YEAR.

MALES.

1. The incomes of A and B are in the proportion of 4 to 5. B pays £9 1s. 3d. at 5d. in the £, what is A's income? Define interest, discount, present worth.

$$\frac{£9\ 1s.\ 3d.}{5d.} = \frac{21\frac{1}{4}}{\frac{5}{12}} = 435$$

A's income = $\frac{4}{5}$ of 435 = £348. Ans.

Interest is money paid for the loan of money and is usually at so much per hundred pounds per annum.

Discount is money deducted from a debt for payment before it is due.

Present Worth is that sum of money which will amount to a given sum in the given time at a given rate per cent.

2. The present worth of a bill due 15 months hence at 4½ per cent. is £133 6s. 8d., true discount being charged. Find the amount of the bill.

£100 : £133⅓ :: £4½ : £7 10s.
Yr. 1 : 1½

£133 6s. 8d. + £7 10s. = £140 16s. 8d.

3. Find the change in my income occasioned by shifting £1,050 from the 3 per cents. at 101⅛ to the 2½ per cents. at 91¾, the usual brokerage of ⅛ per cent. on each transaction being charged.

£1,050 in 3 per cents. produces £31 10s. income.
£1,050 sells for $10\frac{1}{2} \times 101\frac{1}{8} = £1{,}065\frac{3}{4}$.
£1,065¾ produces $\frac{1{,}065\frac{3}{4} \times 2\frac{1}{2}}{91\frac{1}{8}} = £29$.
£31 10s. − £29 = £2 10s. less.

4. A man takes 3 hrs. 45 mins. in walking to a certain place and riding back; he would have gained 1¼ hrs. by riding both ways. How long would he take to walk both ways.

Hrs.	Min.	
3	45	= time for riding and walking.
1	15	= ,, gained by riding both ways.
2 | 2	30	= ,, for riding both ways.
1	15	= ,, ,, one way.
1	15	= ,, longer in walking than riding one way.
2	30	= ,, for walking one way.
2		
Hrs. 5	0	= ,, ,, both ways.

FEMALES.

1. How can it be known from the form of its denominator whether a vulgar fraction can or cannot be expressed as a terminating decimal. Apply your answer to show which of the following fractions can be expressed as terminating decimals:— $\frac{7}{24}$, $\frac{7}{25}$, $\frac{7}{80}$, $\frac{7}{88}$ and express each as a decimal.

If the denominator contains any other factor than 2 or 5 or their multiples it *cannot* be expressed as a terminating decimal.

$$\frac{7}{24} = \frac{7}{2 \cdot 2 \cdot 2 \cdot 3} = .2916\dot{6}.$$
$$\frac{7}{25} = \frac{7}{5 \cdot 5} = .28.$$
$$\frac{7}{80} = \frac{7}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 5} = .0875.$$
$$\frac{7}{88} = \frac{7}{2 \cdot 2 \cdot 2 \cdot 11} = .07954\dot{5}.$$

$\therefore$ $\frac{7}{25}$ and $\frac{7}{80}$ are terminating decimals, the other fractions are not.

2. Simplify the fraction

$$\tfrac{1}{3} \text{ of } 4\tfrac{1}{2} \div \tfrac{11}{60} - \left\{ \frac{2\frac{2}{3}}{1\frac{1}{3}} + \frac{6\frac{7}{15} + 7\frac{3}{5}}{8\frac{1}{3} - 4\frac{1}{2}} \right\}$$
$$\tfrac{1}{3} \times \tfrac{3}{2} \times \tfrac{60}{11} - [\tfrac{15}{5} \times \tfrac{3}{5} + 14\tfrac{2}{15} \div 3\tfrac{6}{15}].$$
$$= 10 - (\tfrac{30}{15} + \tfrac{212}{15} \times \tfrac{15}{62}).$$
$$= 10 - (1\tfrac{14}{31} + 4).$$
$$= 4\tfrac{13}{31}. \text{ Ans.}$$

3. Reduce $\frac{3}{7}$ of 16½ cwt. + ⅗ of 3 qrs. 21 lbs. − $\frac{4}{17}$ of 1 ton 10 cwt. 40 lbs. to the fraction of 5¼ cwts.

$$\frac{\text{cwt.} \quad \text{cwt.} \quad \text{cwts.}}{\tfrac{3}{7} \times \tfrac{49}{3} + \tfrac{3}{5} \times \tfrac{15}{8} - \tfrac{4}{17} \times 30\tfrac{4}{14}}{5\tfrac{1}{4} \text{ cwts.}}$$
$$= \frac{7 + \frac{9}{8} - 7\frac{1}{7}}{5\frac{1}{4}}$$
$$= \tfrac{15}{56} \times \tfrac{4}{21}$$
$$= \tfrac{15}{294}. \text{ Ans.}$$

4. In a chest of mixed tea weighing 1 cwt. 1 qr. 14 lbs., ⅞ of the whole is Congou worth 2s. 4d. per lb., ⅔ of the remainder is Pekoe worth 3s. 6d. per lb., and the rest is Assam worth 4s. 3d. per lb.; find the value of the chest.

1 cwt. 1 qr. 14 lbs. = 154 lbs.

⅞ of 154 at 2s. 4d. = 121 at 2⅓	=	£14	2 4
⅔ of (154 − 121) at 3s. 6d. = 22 at 3s. 6d.	=	£ 3	17 0
(154 − 143) at 4s. 3d. = 11 at 4s. 3d.	=	£ 2	6 9
		£20	6 1

END OF THIRD YEAR.

MALES.

1. What fraction of $\frac{12}{5}$ of a crown is $\frac{8}{15}$ of a guinea?

$$\frac{\frac{8}{15} \times 21}{\frac{12}{5} \times 5} = \tfrac{28}{45} \times \tfrac{1}{15} = \tfrac{28}{225} \text{ Ans.}$$

2. What sum of money lent for two years at 5 per cent. compound interest will amount to £1,358 16s. 7½d.?

£1 becomes 1·05 in one year and 1·1025 in two years, C.I.

£	£	s.
£1·1025 : £1358·83125 :: 1 :	1232	10.

3. Give the rule for extraction of a square root. Find the square root of $\frac{·00875}{1·26}$.

Divide the number into periods by placing a dot over the units' figure, and over every second figure from it. Take the highest square which can be subtracted from the first period and bring down the next period. Double the root for a trial divisor, regarding it as 10 times the number. Place the quotient both in the root and the divisor, multiply by the last figure in the root, and subtract. Repeat this process till all the periods are brought down. If there is still a remainder, bring down two 0's and repeat till there are as many decimal places in the root as needed.

To find the square root of a fraction, extract the root of both numerator and denominator. Or convert it into a decimal fraction and extract the square root of the decimal.

$$\frac{\cdot00875}{1\cdot26} = \frac{875}{126000} = \frac{1}{144}$$
$$\sqrt{\frac{1}{144}} = \frac{1}{12} = \underline{.083}. \text{ Ans.}$$

4. I leave home at 8 o'clock to catch a train. If I walk at the rate of 4 miles an hour I shall be 10 minutes too late, and if I walk at the rate of 5 miles an hour I shall be 5 minutes too soon. How far is the station from my house, and when does the train start?

Difference in time at 4 and 5 miles per hour = 15 mins.

Time gained in 1 mile = 3 mins.

Miles to walk to gain 15 mins. = $\frac{15}{3} = 5$ distance from station.

Time to arrive at station walking 5 miles an hour = 9 o'clock.

Time of train starting = 9 hrs. + 5 min. = $\underline{9.5 \text{ a.m.}}$ Ans.

FEMALES.

1. State clearly and explain the rule for pointing the quotient in division of decimals:

Work as an example ·00749265 ÷ 3·585.

Subtract the number of decimal places in the divisor from the number in the dividend and mark off the difference in the quotient.

If the number of places in the dividend is less than the number in the divisor, add o's till they are equal.

If there are not enough figures in the quotient prefix o's.

By vulgar fractions it can be shown that tenths ÷ tenths, or hundredths ÷ hundredths, &c. = units. It follows therefore that if there are as many decimal places in the dividend as in the divisor the whole of the figures in the quotient will be integers, and the decimal places will then commence, that is, there will be as many decimal places in the quotient as the decimal places in the dividend exceed those in the divisor.

Since ·1 = $\frac{1}{10}$ and ·01 = $\frac{1}{100}$

$\frac{1}{100} \div \frac{1}{10} = \frac{1}{100} \times \frac{10}{1} = \frac{1}{10} = \cdot1$.

This result is the same as subtracting one decimal from two in the dividend.

3·585)·00749265(·00209
7170
32265
32265

2. If 682¾ yds. cloth cost £352 16s. 8d. how many yards can be bought for £396 18s. 9d.?

£352 16s. 8d.	:	£396 18s. 9d.	::	682¾ yds.	:	768$\frac{3}{32}$ yds.
352⅔	:	396½	::	682¾		

$$\frac{\overset{3}{\cancel{6}}}{\cancel{352}} \times \frac{\overset{3}{\cancel{6}35\cancel{2}}}{16} \times \frac{2731}{\cancel{4}\ 2}$$

$$= \frac{24579}{32}$$
$$= \underline{768\tfrac{3}{32}}. \text{ Ans.}$$

3. Reduce the difference between 6·45 of 8¼ guineas and 6·45 of £8¼ to the decimal of £31 17s.

6·45 of 8¼ guin. − 6·45 of £8¼
£31 17s.

$$= \left(6\frac{45}{99} \times \frac{33}{4} \times \frac{21}{20} - 6\frac{41}{90} \times \frac{33}{4}\right) \div 31\frac{17}{20}$$

$$= \left(\frac{639}{\cancel{99}_{3}} \times \frac{\cancel{33}}{4} \times \frac{\overset{7}{\cancel{21}}}{\cancel{20}} - \frac{581}{\cancel{99}_{30}} \times \frac{\overset{11}{\cancel{33}}}{4}\right) \times \frac{20}{637}$$

$$= \left(\tfrac{4473}{140} - \tfrac{5291}{360}\right) \times \tfrac{20}{637}.$$

$$= \frac{13419 - 12782}{240} \times \frac{20}{637}.$$

$$= \tfrac{637}{240} \times \tfrac{20}{637}.$$
$$= \tfrac{1}{12}.$$
$$= \underline{.083}. \text{ Ans.}$$

4. The circumferences of the wheels of a carriage are in the ratio of 3½ to 5¼, and the larger wheel makes 1,110 revolutions in 2½ miles, how many revolutions will the smaller wheel make in the same distance?

3½ : 5¼ :: 1110 : $\underline{1665}$. Ans.

$\frac{2}{7} \times \frac{21}{4} \times \frac{1110}{1}$.

= $\underline{1665}$. Ans.

END OF FOURTH YEAR.

MALES.

1. The selling price of a tradesman's goods is 20 per cent. above what they cost him. He allows a customer 10 per cent. off his bill, thereby clearing £2 2s. 1d. on the goods sold. Find the amount of the bill.

The selling price of £100 worth = £120; 10 per cent. allowed from that reduces it to 108. The actual profit realised on £100 worth = 8 per cent.

8 per cent. = £2 2s. 1d.

∴ 8 : 120 :: £2 2s. 1. : $\underline{£31\ 11s.\ 3d.}$ the amount of the bill.

2. I invest £3,300 in the 3 per cents. at 93⅜ and sell out when the stock is at par, the usual brokerage charge of ⅛ per cent. on each transaction being made. How much do I gain?

S. P. $(100 - \frac{1}{8})$ − C. P. $(93\frac{3}{8} + \frac{1}{8})$
= 6¼ gain.

£		£		£		£
93⅜	:	3,300	::	6¼	:	$\underline{225}$. Ans.

3. Give the rule for extraction of the cube root. A cubical block of stone 2 feet in thickness contains 5 cubic ft. 24 cub. in. Find the length of its edge.

Divide the number into periods by placing a point over the units' place and every other third figure. The number of points will show the number of figures in the root. Find a number, the cube of which is less than the first period, and subtract this cube. Bring down the next period. Place three times the root to the left-hand in a column, and three times the square of the root in a second column. Divide the number in third column by this number, and thus obtain the second figure of the root. Add this figure to the first column, and multiply the sum thus formed by the last figure of the root; place this under the second column, but two places to the right. Add the two together and multiply by the last figure of the root, placing the product under the third column and subtracting. Proceed thus till all the periods are brought down.

$$\frac{5 \text{ c. ft. } 24 \text{ c. in.}}{2 \text{ ft.}} = \frac{8664 \text{ c. in.}}{24 \text{ in.}} = 361 \text{ sq. in.}$$
$$\sqrt{361} = \underline{19} \text{ in. Ans.}$$

4. Find the least number of ounces of standard gold which could be made into an exact number of the new £5 pieces, standard gold being coined at the rate of £3 17s. 10½d. to an ounce.

L. C. M. of £3 17s. 10½d. and £5.
623, 800
= $\underline{498,400}$. Ans.

FEMALES.

1. Define the terms *stock*, *premium*, *par*, *discount*, *brokerage*. How much of a stock which is at 95⅜ can be bought for £856 2s. 6d. (neglect brokerage)?

Stock, the capital of a company or a government.

Premium, the excess of the price of stock or shares above their nominal value.

Par, shares are at *par* when their actual and nominal values are the same.

Discount, shares are at a discount when the actual value is less than the nominal value.

Brokerage, the amount charged by a broker for buying or selling shares.

95⅜	:	100	::	£856 2s. 6d.	:	£900 stock

$\frac{\cancel{381}}{\cancel{4}} \times \frac{100}{1} \times \frac{\cancel{856}}{\cancel{8}}$

= $\underline{900}$. Ans.

2. What principal will produce as interest £289 in 5 years at 4½ per cent. ?

£4½ : 289 :: £100 : £1360
yrs. 5 : 1
$\frac{4}{1^0} \times \frac{1}{5} \times \frac{289}{1} \times \frac{100}{1}$
= £1360. Ans.

3. By selling a house for £1,793 15s. a man lost 12½ per cent. on its cost price; for what sum should he have sold it to gain 12½ per cent. ?

100 − 12½ = 87½ actual selling price.
100 + 12½ = 112½ required
87½ : 112½ :: £1,793¾ : £2,306 5s.
$\frac{7}{1^0} \times \frac{225}{2} \times \frac{7175}{4}$.
= £2,306 5s. Ans.

4. A and B invest £1,500 each for 3 yrs. at 3½ per cent. A allows the interest to accumulate without investment, but B adds the interest to the principal at the end of each year. How much is B. better off than A. at the end of the time. (Neglect fractions of a penny.)

$\frac{1500 \times 3 \times 3\frac{1}{2}}{100}$ = £157 10s. A's interest.
1500 × ·035 = 52·5 1st year's interest.
1552·5 × ·035 = 54·3375 2nd year's interest.
1606·3375 × ·035 = 56.2393125 3rd year's interest.
163·0768125 total interest for B
157·5
£5·5768125
20
11·5362500
12
6·4350000
Diff. = £5 11s. 6·435. Ans.

END OF THIRD YEAR.

Algebra.

MALES.

(Answer two questions only, including question 3 if you can do so.)

1. Multiply $[1 - (p + q)x + (p + q)^2 x^2]$ by $[1 + (p + q)x]$, and divide $a^3 + 8b^3 - 27c^3 + 18abc$ by $a + 2b - 3c$.

$1 - (p + q)x + (p + q)^2 x^2$
$1 + (p + q)x$
$1 - (p + q)x + (p + q)^2 x^2$
$(p + q)x - (p + q)^2 x^2 + (p + q)^3 x^3$
$1 + (p + q)^3 x^3$. Ans.

$a + 2b - 3c)a^3 + 8b^3 - 27c^3 + 18abc(a^2 - 2ab + 3ac + 4b^2 + 9c^2 + 6bc$
$a^3 + 2a^2b - 3a^2c$
$- 2a^2b - 3a^2c + 18abc$
$- 2a^2b - 4ab^2 + 6abc$
$3a^2c + 12abc$
$3a^2c + 6abc - 9ac^2$
$4ab^2 + 8b^3$
$4ab^2 + 8b^3 - 12b^2c$
$9ac^2 + 12b^2c - 27c^3$
$9ac^2 + 18bc^3 - 27c^3$
$6abc + 12b^2c - 18bc^2$
$6abc + 12b^2c - 18bc^2$

2. Prove that $a^{2m} \times a^m = a^{3m}$, and $a^{2m} \div a^m = a^m$, m being any positive integer.

Simplify $\frac{a}{c} - \frac{(ad - bc)x}{c(c + dx)} - \frac{a}{(c + dx)}$.

$a^{2m} = a^{m+m} = a^m \times a^m$
$(a^m \times a^m)\, a^m = a^m \times a^m \times a^m$
$= a^{m+m+m}$
$= a^{3m}$.
$a^{2s} = a^{m+m} = a^m \times a^m$
$(a^m \times a^m) \div a^m = a^m$.

$\frac{a}{c} - \frac{(ad - bc)x}{c(c + dx)} - \frac{a}{(c + dx)}$
$= \frac{a(c + dx) - (ad - bc)x - ac}{c(c + dx)}$
$= \frac{ac + adx - adx + bcx - ac}{c(c + dx)}$
$= \frac{bcx}{c(c + dx)}$
$= \frac{bx}{c + dx}$ Ans.

3. Solve the equations—

(a) $a - \frac{b}{a}(x - a) = b - \frac{a}{b}(x - a)$
$- \frac{b}{a}(x - a) + \frac{a}{b}(x - a) = b - a$
$- b^2(x - a) + a^2(x - a) = ab^2 - a^2b$
$- b^2x + ab^2 + a^2x - a^3 = ab^2 - a^2b$
$(a^2 - b)x = a^3 - a^2b$
$x = \frac{a^3 - a^2b}{a^2 - b^2} = \frac{a^2(a - b)}{a^2 - b^2}$
$= \frac{a^2}{a + b}$. Ans.

(b) $\frac{8x + 5}{6} - \frac{5x - 7}{4} = 4\frac{1}{2} - \frac{2x - 1}{3}$
$16x + 10 - 15x + 21 = 54 - 8x + 4$
$9x = 27$
$x = 3$. Ans.

END OF FOURTH YEAR.

1. (a) Find the G.C.M. of $20x^4 + x^2 - 1$ and $25x^4 + 5x^3 - x - 1$.

$20x^4 + x^2 - 1)\ 25x^4 + 5x^3 - x - 1(5$
$100x^4 + 20x^3 - 4x - 4$
$100x^4 + 5x^3 - 5$
$20x^3 - 5x^2 - 4x + 1$
$20x^3 - 5x^2 - 4x + 1)\ 20x^4 + x^2 - 1\ (x + 1$
$20x^4 - 5x^3 - 4x^2 + x$
$5x^3 + 5x^2 - x - 1$
$20x^3 + 20x^3 - 4x - 4$
$20x^3 - 5x^3 - 4x + 1$
$5)25x^2 - 5$
$5x^2 - 1$
$5x^2 - 1)\ 20x^3 - 5x^2 - 4x + 1(4x - 1$
$20x^3 - 4x$
$- 5x^2 + 1$
$- 5x^2 + 1$
G. C. M. = $5x^2 - 1$.

(b) Prove that in the process of finding the G. C. M. of two quantities, either dividend or divisor may be multiplied by any factor not common to the other.

In order to avoid *fractional coefficients* in the quotients it is usual in performing the operations for finding the G. C. M. to *reject* certain factors which do not form part of the G. C. M. required.

Suppose we have to find the G. C. M. af A and B; and at any stage of the process suppose we have the expressions K and R, one of which is to be a dividend and the other a divisor. Let $R = mS$, where m has no factor which K has; then m may be rejected: that is, instead of continuing the process with K and R we may continue it with K and S.

For we know that A and B have just the same common measures as K and R have.

Now any common measure of K and S is a common measure of K and R, and is therefore a common measure of A and B.

And any common measure of K and R is a common measure of K and mS. But m has no factor which K has. Therefore any common measure of K and R is a common measure of K and S. Hence any common measure of A and B is a common measure of K and S.

Thus we see that A and B have just the same common measures as K and S have; and this is what we had to shew.

A factor of a certain kind may also be *introduced* at any stage of the process.

Suppose we have to find the G. C. M. of A and B; and at any stage of the process suppose we have the expressions K and R, one of which is to be a dividend and the other a divisor. Let $L = nK$, where n has no factor which R has; then n may be introduced: that is, instead of continuing the process with K and R we may continue it with L and R.

For we know that A and B have just the same common measures as K and R have.

Now any common measure of K and R is a common measure of L and R; so that any common measure of A and B is a common measure of L and R.

And any common measure of L and R is a common measure of nK and R. But n has no factor that R has. Therefore any common measure of L and R is a common measure of K and R, and is therefore a common measure of A and B.

Thus we see that A and B have just the same common measures as L and R have; and this is what we had to shew.

Todhunter.

2. Simplify:—

$$(x-1)\left(1+\frac{x}{1-x}\right)\left(1-\frac{x}{1+x}\right)\div\left\{1-\frac{1+x^2}{x}\right\}$$

and show that if the sum of any two quantities $=\frac{p}{q}$, then $p\times$ their difference $= q\times$ the difference of their squares—

$$(x-1)\left(1+\frac{x}{1-x}\right)\left(1-\frac{x}{1+x}\right)\div\left\{1-\frac{1+x^2}{x}\right\}$$

$$\frac{x-1}{1}\times\frac{1}{1-x}\times\frac{1}{1+x}\times\frac{x}{-1+x-x^2}$$

$$=\frac{1-x}{1}\times\frac{1}{1-x}\times\frac{1}{1+x}\times\frac{x}{1-x+x^2}$$

$$=\underline{\frac{x}{1+x^3}}.\quad\text{Ans.}$$

Let a and b be the two quantities.

$$\text{Then } a+b=\frac{p}{q}\quad\text{(Hyp.)}$$

$$(a+b)q=p$$

$$(a+b)(a-b)q=p(a-b)$$

$$(a^2-b^2)q=(a-b)p$$

3. Solve the equations:—

(a) $ax+by=a^2$

$bx+ay=b^2$

$abx+b^2y=a^2b$

$\underline{abx+a^2y=ab^2}$

$$(b^2-a^2)y=a^2b-ab^2$$

$$y=\frac{ab(a-b)}{b^2-a^3}$$

$$y=\frac{-ab}{a+b}$$

$$ax=a^2-b\left(\frac{-ab}{a+b}\right)$$

$$ax=\frac{a^3+a^2b+ab^2}{a+b}$$

$$x=\frac{a(a^2+ab+b^2)}{a(a+b)}$$

$$x=\frac{a^2+ab+b^2}{a+b}$$

(b) $\frac{7}{3x-4}-\frac{2}{x+2}=1.$

$3x^2+2x-8=7x+14-6x+8$

$3x^2+x=30$

$x^2+\frac{x}{3}=10$

$x^2+\frac{x}{3}+(\frac{1}{6})^2=10+\frac{1}{36}$ or $\frac{361}{36}$.

$x+\frac{1}{6}=\pm\frac{19}{6}$

$x=\pm\frac{19}{6}-\frac{1}{6}$

$x=3$ or $-3\frac{1}{3}$.

END OF THIRD YEAR.

Mensuration.

MALES.

(Answer one question.)

1. Find, in acres, the area of a triangle whose sides are 29, 52, and 69 chains.

$$\frac{29+52+69}{2}=75$$

$$75(75-29)(75-52)(75-69)=476100 \text{ chains}$$

$$=\sqrt{4761}\text{ acres}=\underline{69\text{ acres.}}\quad\text{Ans.}$$

2. The diagonal of a four sided field is $9\frac{3}{5}$ chains, and the perpendiculars upon it from the opposite angles are $6\frac{1}{2}$ and $10\frac{1}{4}$ chains; what is the cost of mowing the field at 8/6 per acre?

$(6\frac{1}{2}\times9\frac{3}{5}\times\frac{1}{2})+(10\frac{1}{4}\times9\frac{3}{5}\times\frac{1}{2})$ chains at 8s. 6d.

$(\frac{13}{2}\times\frac{48}{5}\times\frac{1}{2})+(\frac{41}{4}\times\frac{48}{5}\times\frac{1}{2})$ at 8s. 6d.

$\frac{156}{10}+\frac{492}{10}$ at 8s. 6d. per acre

$^{3}\frac{24}{10}^{2}\times\frac{17}{2}\times\frac{1}{10}$

$=\frac{8424}{100}$

$=68{\cdot}91375$

$=\underline{£3\ 8s.\ 10{\cdot}965.}\quad\text{Ans.}$

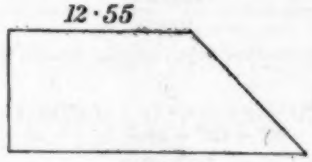
END OF FOURTH YEAR.

1. Find the expense of planting the circumference of a circular piece of ground whose diameter is 126 feet with quicks one yard apart at 1s. 6d. ($\pi=\frac{22}{7}$).

$126\times\frac{22}{7}\div3=132$ yards

132 at 1s. 6d. $=\underline{£9\ 18s.}$ Ans.

2. Two opposite sides of a four sided field are parallel. Their lengths are 12 chains 55 links and 14 chains 73 links, and the distance between them is 10 chains 36 links; find the area in acres, &c.



$$\frac{12{\cdot}55+14{\cdot}73}{2}\times10{\cdot}36$$

$=141{\cdot}3104$ chains

$=14{\cdot}13104$ acres

4

·52416

40

$\underline{20{\cdot}96640}$

$\underline{14\text{ ac. }0\text{ rd. }20{\cdot}9664\text{ per.}}\quad\text{Ans.}$

END OF SECOND YEAR.

Euclid.

MALES.

[All generally understood abbreviations and symbols for *words* may be used, but not symbols of operation, such as —, +, ×.]

(Answer two questions, including Question 3, if you can do so.)

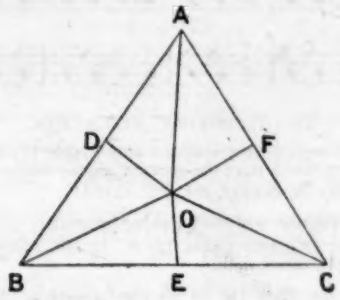
1. From a given point draw a straight line equal to a given straight line.

Euclid, Book I., Prop. 2.

2. If from the ends of the side of a triangle two straight lines be drawn to a point within the triangle, these shall be less than the other two sides of the triangle, but shall contain a greater angle.

Euclid, Book I., Prop. 21.

3. If the three angles of a triangle are bisected by lines meeting in one point, show that the perpendiculars from that point on the sides are equal.



Let the three angles A, B, C, be bisected by lines meeting at O, and let the perpendiculars OD, OE, OF be drawn to meet AB, BC, CA.

Then OD, OE, OF are equal.

∴ in triangles ODB, OBE, the angle OBD = OBE and angle ODB = angle OEB (Const.), and side OB is common.

∴ (I. 26) OD = OE

In like manner OF may be shown to be equal to OD.

Wherefore, &c. Q.E.D.

END OF THIRD YEAR.

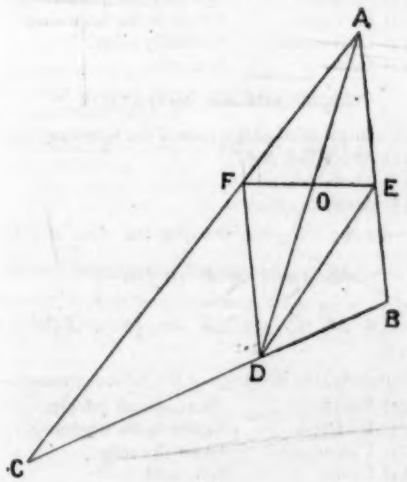
1. If two triangles have two angles of the one equal to two angles of the other, each to each, and the sides adjacent to the equal angles in each equal to one another, then shall the other sides be equal, each to each, and also the third angle of the one equal to the third angle of the other.

Euclid, Book I., Prop. 26, part first.

2. Parallelograms upon the same base and between the same parallels are equal to one another.

Euclid, Book I., Prop. 37.

3. If the angle A in the triangle ABC be bisected by the line AD meeting BC in D, and DE, DF be drawn parallel to CA, BA respectively, show that DE equals DF, and that FE is perpendicular to AD.



1st Part.—Construct the figure
ang. FDA = ang. EAD (I. 29),
ang. EAD = ang. FAD (Const.),
∴ ang. FDA = ang. FAD
∴ FD = FA.
By construction AFDE is a parallelogram.
∴ FA = ED
∴ FD = ED. Q.E.D.

2nd Part.—Join FE
ang. FAD = FDA (proved above);
ang. DFE = ang. AED (I. 29)
AF = AE (proved as FD was proved equal to ED)
∴ ang. AFE = ang. AEF
∴ ang. AFE = ang. DFE
∴ ang. FOD = ang. FOA (I. 32)
∴ both are right angles def. 10. Q.E.D.

END OF FOURTH YEAR.

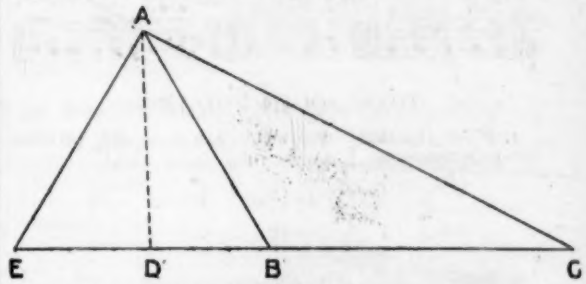
1. If a straight line be divided into any two parts, the squares on the whole line and on one of the parts are equal to twice the rectangle contained by the whole and that part together with the square on the other part.

Euclid, Book II., Prop. 7.

2. To divide a given straight line into two parts so that the rectangle contained by the whole line and one of the parts shall be equal to the square on the other part.

Euclid, Book II., Prop. 11.

3. In the triangle ABC the square on AC is equal to the squares on AB, BC, and the rectangle AB, BC; show that the angle ABC is two-thirds of two right angles.



Let ABC be the triangle, draw AD perpendicular to CB produced.
By Euclid II., 12.
Sq. on AC = sq. on AB + sq. on BC + twice rect. BD, BC
In the question.
Sq. on AC = sq. on AB + sq. on BC + rect. AB, BC.
∴ twice rectangle, BD, BC = rect. AB, BC
∴ twice BD = AB, make DE equal to DB and join AE.
Then EB = AB, also AE = AB (both are equal to the sum of the squares AD, BD.)
∴ AE = EB
∴ ABE is an equilateral triangle. Q. E. D.

END OF FIRST YEAR.

Composition.

[The passage should be read *once* distinctly, and then the substance of it is to be written down from memory.]

A young lady left a farm-house on the shores of the Bay of Fundy, and took her way across the sands to a village. The inmates of the farm-houses, knowing the tide would soon set in, and noticing that she was behind the time of her return, grew very anxious for her safety.

A young farmer quickly saddled a strong fleet horse, accustomed to running on the sands. After a rapid gallop the lady was discovered; she had been running, and was now standing quite still as if hopeless of reaching the shore. She was pulled up and placed on the saddle, and then began a terrible race between the speed of the horse and the rush of the tide.

Yard by yard it crept up; nearer and nearer came the strange, hoarse rush of the waters, and the white waves could be seen breaking some distance away. Just as a hungry wave rushed upon them, the good horse leaped from the sands to the hard dry shore and they were safe.

END OF FIRST YEAR.

Music.

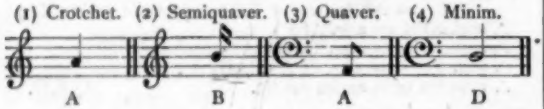
STAFF NOTATION.

(A quarter of an hour allowed for this paper.)

[N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*.]

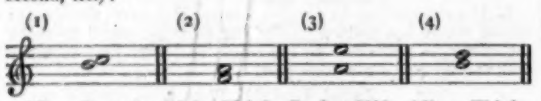
1. Write above each of the following its value-name (crotchet, &c.), and below each its pitch name (C, D, E, or *Do*, *Re*, &c.):

(1) Crotchet. (2) Semiquaver. (3) Quaver. (4) Minim.



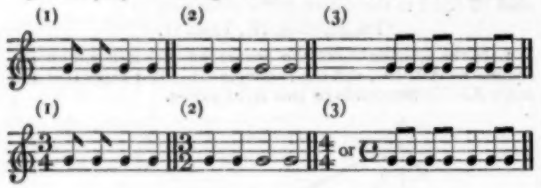
A B A D

2. Write below each of the following its name (major second, &c.):



Minor Second. Major Third. Perfect Fifth. Minor Third.

3. Add proper time-signatures to each of the following bars:



TONIC SOL-FA NOTATION.

1. Write (1) three three-pulse measures and (2) two two-pulse measures.

(1) | : : | : : | : : ||

(2) | : | : ||

2. Write the names of the following intervals:

(1) *fah* to *te*, pluperfect fourth or tritone, (2) *soh* to *lah*, major second, (3) *fah* to *doh*^{1}, perfect fifth, (4) *ray* to *fah*, minor third.

3. Write the following an octave higher, *doubling* the value of each note:

| m :s$_1$ | r :— | d :— ||

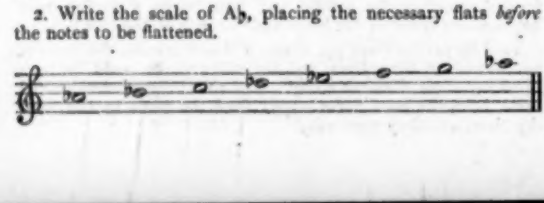
| m^1 :— | s :— | r^1 :— | :— :— | d^1 :— | :— :— ||

END OF SECOND YEAR.

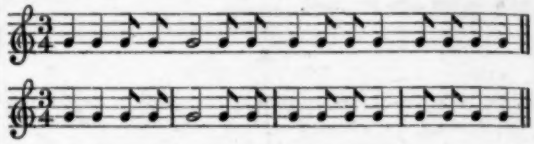
STAFF NOTATION.

1. Add a minor sixth above each of the following notes:

2. Write the scale of A♭, placing the necessary flats *before* the notes to be flattened.



3. Add bars to the following in accordance with the time-signature:



TONIC SOL-FA NOTATION.

1. Which tones of the common major scale (1) are leaning tones, and (2) which have the greatest leaning tendency?

(1) *fah*$_1$ *ray*$_1$ *te*, (2) *ray*, *fah*.

2. Write the names of the following intervals:

(1) *soh* to *ray*^{1}, perfect fifth, (2) *te*$_1$ to *lah*, minor seventh, (3) *fah* to *lah*$_1$, minor sixth.

3. Write the signs (1) for six-pulse measure, (2) for four-pulse measure, (3) for nine-pulse measure.

(1) | : : | : : ||

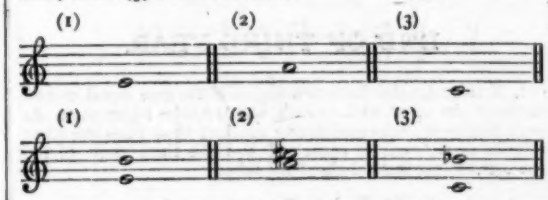
(2) | : : ||

(3) | : : | : : | : : ||

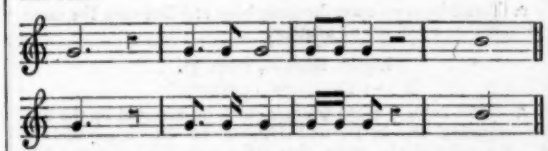
END OF THIRD YEAR.

STAFF NOTATION.

1. Write above (1) a perfect or major fifth, above (2) a major third, above (3) a minor seventh.



2. Re-write the following, halving the value of every note and rest:



3. State (briefly) the meanings of the following terms:—

(1) Staccato.	Short, cut off quickly.
(2) Da Capo.	Return to the beginning.
(3) Diminuendo.	Gradually softer.
(4) Lento.	Soft, mild.

TONIC SOL-FA NOTATION.

1. Write a minor third above each of the following notes:

(1) Above *fah*, *fah le*.
(2) Above *soh*, *soh ta*.
(3) Above *te*$_1$, *te*$_1$ *ray*.

2. Re-write the following, doubling the value of each note and rest:

| s :s.m | .s : d^1 | s.,f: m ||

| s :— | s :m | :s | d :— | s :-.f | m :— ||

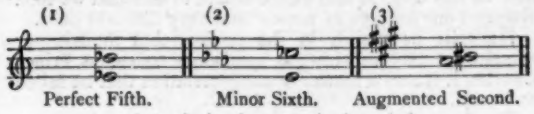
3. State (briefly) the meanings of the following terms:—

(1) Staccato.	Short, cut off quickly.
(2) Da Capo.	Return to the beginning.
(3) Diminuendo.	Gradually softer.
(4) Lento.	Soft, mild.

END OF FOURTH YEAR.

STAFF NOTATION.

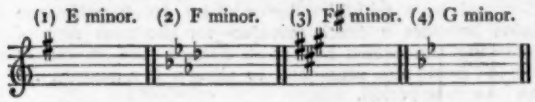
1. Write below each of the following intervals its name (major second, &c.):



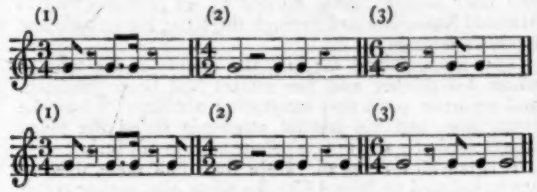
Perfect Fifth. Minor Sixth. Augmented Second.

2. Write the signatures of the following minor keys:

(1) E minor. (2) F minor. (3) F♯ minor. (4) G minor.



3. Complete each of the following bars by adding *one* note at the end:



TONIC SOL-FA NOTATION.

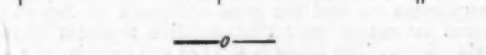
1. If the first note of the following passage is regarded as *soh*, what will the others become?

r	m	fe	s	l	r	fe	l	t	s
s	l	t	d¹	r¹	s	t	r¹	m¹	d¹

2. What are the names of the following notes?

(1) *ray* sharp. (2) *lah* flat. (3) *soh* sharp.
(1) *re* (2) *le* (3) *se*

3. Write (in figures) over each note and rest in the following passage its value in pulses or fractions of a pulse:



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Publications Reviewed.

PRIZE BOOKS.

Messrs. Blackie and Son's Publications.

First Notice.

Once more we have the pleasure of drawing attention to this well known firm's annual issue of books suitable for presents and prizes.

In outside appearance, and in general get up, the volumes before us are as attractive and as beautiful as ever. They are all illustrated, with more or less power, with regard to which we shall in some cases refer, when dealing with the works in detail.

(1) Aunt Hesba's Charge. By Elizabeth Lysaght.

This is a very unpretending little story of a boy and girl, whom circumstances throw under the care of an old maiden lady, who is their great aunt. At first she and they do not mutually understand one another, but after a time all comes right, the moral seeming to be that old maids, however proper and particular, have hearts, and can easily learn to care for the love of children.

The story is more fit for a girl than a boy.

(2) Chirp and Chatter. By Alice Banks.

As long, no doubt, as the world lasts, we shall have imitators of the immortal Æsop, who will try and teach moral lessons through the mouths of the lower animals.

The lessons inculcated here are very good, and the authoress has succeeded very fairly in her efforts to amuse while she instructs.

In the second sketch, which is called the Self-deceived Mag Pye, the writer has produced a certain amount of mystery between the bird and a curate, whose name happens to be Pye, which we are bound to add we do not consider very artistic.

The illustrations are very numerous and bold in idea, though not very highly finished in execution.

We might especially recommend the book to old ladies to read to their little grandchildren, for the print is exceptionally large and clear.

(3) The War of the Axe. By J. Percy-Groves.

This is a charming volume for boys, and cannot but do such any amount of good.

The hero is a boy born at the Cape, but educated at Rugby under Arnold and Tait, the story however commencing with the account of his return home. On the way they pick up a gentleman and his young son and daughter, who have been shipwrecked, and the former of them turns out to be known to the father of the lad.

After arriving home, whither the shipwrecked trio accompany our hero, they soon begin to make excursions up the country for different purposes, and there meet with all sorts of those adventures of which boys love to read.

The story shows undoubted acquaintance with the country and people described, and would, therefore, impress a good deal of useful information on an intelligent boy's mind.

(4) Miss Willowburn's Offer. By Sarah Doudney.

It is quite impossible for this lady, whose books we have so often noticed, to write anything which is not pleasant to read; at the same time we are sorely puzzled as for what class of readers this particular volume is intended.

The dear old, or perhaps we ought to say middle-aged lady, whose name appears on the title-page, is scarcely the real heroine of the book.

The one around whom centres the greatest interest is very little more than a heartless adventuress, who, being very beautiful as a child, was taken up and educated by some lady, who does not figure in the story, to adorn her drawing-room with.

This beautiful creature becomes engaged to a young sailor, whose death we read of in the first few pages, and he commends her to the care of his mother and sisters, with painful results.

The story is told by one of these sisters, who is a young widow, and a very great friend of Miss Willowburn. We can scarcely refer to any others who figure in the story without telling more of the story than we wish to.

Interesting as the story is, we cannot think it would do any girl, even of eighteen or more, any good to read it.

(5) Chivalric Days. By E. S. Brooks.

This is a collection of short stories taken from history, in which the chivalric doings of boys or girls are recounted.

The stories range, as to time, from Nita, the daughter of Sebu, who became the Queen of Egypt more than four thousand years ago, to the evacuation of New York by the English, some hundred years ago, of which the earlier story, by the way, is called 'Cinderella's Ancestor.'

Each narrative occupies about twenty-five or thirty pages. Two of them, however, are longer and subdivided, viz., 'The Field of the Cloth of Gold,' and 'Monsieur; the Captain of the Caravel,' the former of which includes no less than four distinct accounts, and the latter three.

One of the sketches is that of young King Richard II. meeting the rebels at Smithfield—which, however, is not now the great cattle market of London as stated here—and of the death of Wat Tyler. The author tells his boy readers that after the leader of the rebels had been stabbed by the Lord Mayor, it was an attendant of the King, named John Cavendish, who despatched him as he lay at the boy King's feet. In a sort of appendix to the story, the author, neither very wisely nor, to our mind, very kindly, adds the following allusion to the Phœnix-park murders, which, four years ago, wrung the heart of the kingdom. In speaking of the murderers on that occasion, he says, 'Their deed was dastardly, but thus "time brings its own revenges," for this young Lord Cavendish, who fell beneath the assassins' knives in Phœnix-park was a lineal descendant of that same John Cavendish, of Suffolk, "one of the King's Squires," who on the 15th of June, 1381, stabbed to death Wat Tyler, the blacksmith, as he lay helpless before the Abbey church at Smithfield.'

We do not know, but we fancy from one or two little matters, that the book comes to us from America, *e.g.*, we might mention the spelling of 'somerset,' as thrust upon our attention by its reproduction at the foot of a picture, which would fain show how 'the King of France, who was an expert wrestler, tripped up the heels of his brother of England, and gave him a marvellous somerset.' Whether it came from America or not, however, we feel sure it will have a cordial welcome, into whatever English home it may find itself, as it is thoroughly healthy in its tone. We also believe that boys and girls dearly love to read true stories, of those, that is, who have really lived, and are not the creation of the fictionist's brain.

(6) Orange and Green. By G. A. Henty.

It is a happy thought of this best of historical-story writers to tell his thousands of boy admirers at this particular time something of the history of Ireland. No lad, however young, can possibly escape hearing much about this unhappy country, and it is as well therefore that he should know how its troubles arose and have been kept alive.

In the story before us we meet, amongst others, with two lads, of whom one is the grandson of a landowner who was dispossessed of most that he had by the edict of Cromwell, and the other a grandson of the very Puritan to whom the other's lands had been assigned.

The former of these lads, who may be considered the hero of the story, accompanies his father, though too young to go at first as an officer, in the campaign which began with the siege of Derry. At this siege the other lad, who was imprisoned in the town, behaves in the noblest way, though not as a soldier, nor in at all a military manner.

We have the usual amount of incident, as found in Mr. Henty's writings, but through it all there is an unusual amount of history woven.

A young lady too as usual plays her part in the story—she and her mother being saved in the midst of insult and robbery, which they are suffering at the hands of the mercenaries of their own side, by the Royalist lad—who by this time is a cornet—and a few of his men. Later on the lad's mother and young brother are also protected in their home by those who differed from them in politics.

We need only add that the work is not only amusing and instructive, but it is also one, as all Mr. Henty's works are, likely to make any lad desire to be a noble and useful member of society, whether he be a soldier or aught else.

(7) Bonnie Prince Charlie. By G. A. Henty.

On commencing the perusal of this story we were almost sorry that Mr. Henty had again gone to the annals of these our islands, for the section of history to be impressed upon his readers.

Most school boys and girls know something about the younger Pretender's efforts to regain the throne of the Stuarts, whereas there are many facts in foreign and ancient history which boys should know, and which they are far less likely to meet with in their ordinary school work.

Our task, however, is not to discuss what work Mr. Henty might have done, but that which he has done, and how he has done it, and we are bound to add that we soon changed our feelings of sorrow into very different ones.

He tells us plainly in the preface that though our sympathies may be with the handsome courteous Prince Charlie, it is still a matter of congratulation that he failed as he did.

The hero of the tale is one who is introduced to us as an infant of two years old, who is brought from France to Scotland by a faithful follower of his father, when the latter becomes a State prisoner—for the rash step of marrying the richest heiress in France—the mother of the lad being also sentenced to remain in a convent for an indefinite period.

A considerable portion of the book is taken up with the account of how the boy eventually got to see his mother, and after distinguishing himself as an aide-de-camp to Marshal Saxe, obtained through the latter his father's and mother's release.

This act obtained for him the enmity of the man to whom his mother and her estates had been promised, and we have some very interesting accounts of how the young man and his faithful attendant foiled the many efforts made by this unscrupulous man to kill him.

It is not till the story is more than half done, that we are introduced to Prince Charlie, when the author seems to make up for lost time by giving more direct history and less story than is quite his wont.

We have no heroine, it is true, but we doubt if Mr. Henty has ever given a more artistic study than the faithful old Scotch attendant, who is scarcely ever absent from the story.

(8) Girl Neighbours. By Sarah Tytler.

This story is drawn on somewhat new lines. We are introduced to two houses, the smaller of which had been some years before built for a mother and sister by some young squire on his marriage. These houses and gardens were most carefully linked together to keep the old lady as near her former home as possible; and when the story opens we find the good occupants of the smaller house lamenting over the excessive nearness of these habitations. The larger house has just been let to a City merchant, and these good people fear all sorts of difficulties and trials as in store for them and their son and daughter.

For a time the two families see nothing of one another, but a trouble brings them together, first as acquaintances, which acquaintanceship is cemented into friendship by further trials.

It is not till the story is more than half told that the young man returns from college to the cottage.

Two sisters, one a professional nurse, and the other a lecturer on cookery, enter into the story, and are indirectly the means of sending the unmarried daughter of the merchant and the only daughter of his neighbour to college.

Some of the conversations are very long, and though containing many valuable remarks, are slightly tedious.

The volume will be found a valuable prize for any elder girl, and as such we recommend it.

(9) Aboard the Atalanta. By Henry Frith.

That 'truth is stranger than fiction' no one doubts, but we cannot help thinking that our author in this case has almost gone beyond the bounds of possibility in the way in which the events of this story, enacted in different places, involve the same actors.

A lad who at school almost witnesses a murderous attack on a young man, meets the would-be assassin as a mutineer on board the very boat whose name appears on the title page. Again an unfair whipping drives this same

lad, who tells his own story, as a runaway from school; on the banks of the canal he is thrown into the water by the tow-rope of a barge; someone on board succeeds in saving his life and drags him on board, whence he does not get away until they are in the Thames. He is however traced and on the point of being given up to the Bargee when he escapes, and gets on board the very boat, a blockade runner, which has on board the contraband material of war this particular barge had brought down the river; and whose master was the brother of the very man we left as dead in the earlier pages of the book.

We are bound to add that the story is very interesting and the descriptions most graphic, and we doubt if any boy after reading it would be tempted to the great mistake of running away from school under almost any pretext whatever.

(10) **Our General.** By Elizabeth J. Lysaght.

Our General, we are told at once, is not a man in cocked hat, feathers, &c., but only an elder daughter of a poor invalid lady, who manages her brother and sister with that innate power of command some young people possess.

The story is told by the sister of the doctor of the little seaside town, who lets a house of his own to this poor lady and her children whilst her husband is settling his affairs in Australia.

The book is called one for girls, and for such we assure our readers it will be found very useful and entertaining.

(11) **Gutta-Percha Willie.** By George Macdonald, LL.D.

No one knows better how to write for children than Dr. Macdonald. He seems, as it were, to become a child again in his intense sympathy with them in their dangers, temptations, and desire for knowledge.

We have here the story of a thoughtful, sympathetic little lad, who amongst other things found a well in his father's garden, which proved of considerable value from a medicinal point of view.

Not even children, though, we fancy, read Dr. Macdonald's books so much for the story as the suggestions and the lessons he would convey to them. They love to be taught, as it were, how to think and to notice, and this is just what they cannot help learning from such books as these. Had we space we would fain quote page after page. All we have room to say is, get it for your boys and girls to read for themselves, and if they can't do that, read it to them.

(12) **The Bubbling Teapot.** By Mrs. Lizzie W. Champney.

This is called a wonder story, but such stories have to be very well done to interest children.

The little girl to whom we are introduced in the first chapter is going to sit to an artist for a picture; whilst she is in his studio, he runs out to purchase a piece of Japanese ceramic ware, but before his return his model has been turned into a teapot. He brings with him a Japanese who happens to be a magician, and he immediately recognises the transformation and gets possession of the animated teapot. He takes it back to Japan and there makes money by exhibiting its wonderful powers of dancing on a tight-rope. One day he is exhibiting it to a Chinese lady of rank, and she, failing to buy it, steals it. For her new owner, however, the teapot refuses to dance, because she fancies that if she will not do so, they will use her as a teapot and if they should, and boil water in her, she knows (for she has heard the magician say so) she will become transformed into a girl again. Sure enough the transformation takes place and she finds herself a little Chinese girl, and as such is accepted by the lady as her daughter who had died.

We need not follow the legend further; the child becomes a girl of all sorts of different countries, the moral or outcome of the story seeming to be that of all children in the world none are so happy as those of dear old England.

(13) **Stories of Old Renown.** By Ascott R. Hope.

These are modernised forms of old stories, which were better known to our fathers than to ourselves. Some of them are slightly altered, shortened and purified of anything that could be considered objectionable.

Of these stories there are no less than nine, amongst which we noticed Guy of Warwick, Patient Griselda, Peter and Magdelona, and Geneviève de Brabant.

They are told in a very easy style and are decidedly pleasant reading, and will, we feel certain, be enjoyed by the lads that read them.

(14) **For the Temple.** By G. A. Henty.

When we noticed this well-known author's story of Bonnie Prince Charlie, where we stated that we were sorry Mr. Henty had not taken an episode in History less known, as the centre around which to mould his story, we little thought that he had a story like the present in store for us.

On the title page we read that the destruction of Jerusalem is the leading fact of the story.

More than one novel has already been written and become famous, in which this great historical fact is so used; but Mr. Henty treats the story in his own way.

The one fictitious individual of any note who figures in this story, is the son of a man living on the shores of the Lake of Tiberias. As a boy, he is out with his affianced bride on the lake, and when almost drowned by one of the sudden squalls not unfrequently experienced there, is saved by the galley of Josephus. The latter, struck with the spirit of the boy, attaches him to himself as one of his body guard, and takes him to Jotapata. There the lad finds a boy who knows more of the place than any other of the boys, and with him, when the place is taken, is saved. After this he himself enrols a band of Jews to fight the Romans, and is constantly harassing them, even coming in contact with Titus himself. We find him in several places before the sacred city itself has to succumb, he is then, with his boy friend of Jotapata, taken as a prisoner, and sold as a slave. At the very end, however, we hear of him as having accepted the faith of Christianity, and hints are here given that he taught the same, with more or less effect, to Titus himself.

We need only add that the work is well worthy of the author.

Messrs. Hodder and Stoughton's Publications.

First Notice.

(1) **Harry Milvaine.** By Gordon Stables, M.D., R.N.

Dr. Stables, believing that not only is the boy the father of the man, but that no less is the child the father of the boy, has given his readers quite a full account of the very young boyhood of his hero.

We have all of us heard of the clever hare, when pursued by greyhounds, running backwards and forwards under a gate, whilst the dogs leapt far beyond it; the same idea occurred to our small hero, when pursued by a bull, which he himself had purposely infuriated for the fun of the thing, that he also could scramble in and out of the field faster than the bull could. Later on, however, the bull has his revenge, for he imprisons the lad and his governess for a whole night in a tree.

The lad having made up his mind to go to sea, runs away and gets on board a fur-seeking ship in a very funny but perfectly possible way, where he is by no means badly treated. After this he gets into the Royal Navy, and is left in charge of a slave dhow which the gunboat to which he is attached has captured; the dhow, however, is driven on shore, into the very hands of its late

owner, who seizes upon slaves and all, and is preparing to sacrifice our hero by fire, when the latter is saved by a superstitious Mahomedan, but only to become the latter's slave.

From this point the story takes a new line, the scene being laid in the interior of Africa, and the interest is well kept up, incident following incident.

Dr. Stables does not however only wish to amuse—he would no less instruct, his boy readers, and this too he does in *propriâ personâ*, stopping his story for the purpose. He is very strong on the subject of kindness to animals, and even almost preaches the doctrine that we may hope to meet our faithful brute friends in another world.

On the whole we think the work one of the best for lads we have seen for a long time, and heartily recommend it.

There are some full-page illustrations, but the volume would be as well without them, in one case the artist not having taken the trouble to study the story sufficiently to know whether the lad, as he left his home, was carrying a stick or a gun; at the same time we are bound to add that some of the landscapes are very effective.

(2) Barbara. By Clara Vance.

This is called on the title-page a story of cloud and sunshine, but the former, we are bound to say, very considerably predominates.

At the outset we are introduced to a family to whom pretty nearly every trouble short of bereavement by death had come: the father is paralysed, the son gone, no one knows whither, with the suspicion over him of having stolen a sum of money so large as to cause his father's bankruptcy, to say nothing of poverty and its attendant evils; but at the end all comes right.

The book is essentially American in its tone, but the lessons taught are useful.

The interest of the story is well sustained, and the character of the heroine cleverly depicted.

(3) Sukie's Boy. By Sarah Tytler.

This story covers a great many years and gives us more or less of the history of three generations.

The woman whose name appears on the title-page is a good faithful spinster, living with her clever old father, who takes charge, on the death of its mother, of her scamp of a brother's baby.

Shortly after the birth of his son this scapegrace runs away, accompanied by his sister's husband, who no less deserts his wife and child than the other does his son.

These children are brought up together, and of one we read as a man, even after he is married.

The story is not particularly interesting, but the characters are well drawn, and the teaching unexceptional.

National Society's Publications.

First Notice.

These volumes are perhaps the cheapest and the best got up which we have seen this season. The names of the authors, or at any rate of some of them, are sufficient to guarantee the value of the works, and to justify any prize or present giver in choosing such without even a glance at their contents.

(1) Prentice Hugh. By Frances Mary Peard.

This is a charming story of a lad, who, with a great desire to serve King Edward as a soldier, promises his father that he will follow his trade as a carver. This is all the harder for him to do, since more than once he had the opportunity of serving those who would have led him to fight the king's battles.

The father of the lad, hearing of work at Exeter, takes his lad there from Stourbridge Fair, where he had been selling some of his own wood carvings; on his way there he falls in with the captain of a coasting vessel and accepts his offer to take him from London to Devonshire; the ship is wrecked, but the travellers are saved. On reaching Exeter they are met by a master stone cutter, who is working at the cathedral, and by him most kindly entertained.

The poor man, however, who is in a very bad state of health, soon dies, and the lad is taken charge of and becomes the apprentice of this good man.

We need not follow the lad through all his trials and successes; suffice it to say, that he does good work in the cathedral and receives the Bishop's blessing.

The authoress in her preface expresses a fear that she may have been guilty of a few anachronisms; whether she has or no, she has certainly given her readers a lively description of the strange customs of the times, especially of those connected with the many holidays then demanded by the church.

(2) Under the Storm. By Charlotte M. Yonge.

No work stamped with this gifted lady's name, since Guy of Redcliffe took all English readers hearts by storm, can but receive a respectful welcome. Whether she write a novel, or a history, or, as here, a story for children, the wondrous talent and desire to raise a high standard of excellence for her readers to emulate, are equally apparent.

The hero of this pretty story is a lad who lived during the civil wars of the seventeenth century. Though not actually mixed up in the war itself, he and his younger brothers and sisters are very considerably affected by it.

At the outside we find the rector of the parish and his churchwarden, who is the father of these children, hiding in a cavern the sacred vessels of the church.

This cavern had been a favourite play-place of the little lad and his sister, and, as he thought, only known to them. When therefore he found his father and the clergyman there he was at first vexed. He, however, accepts the secret, with the permission to tell his sister. In after times right nobly does he keep this secret when some of the Roundheads, feeling sure that he knows where the sacred vessels are, severely whip him because he will not tell.

Shortly after the tale commences this little lad's father is killed, his home burnt down, and, deserted by his elder brother, who joins the Parliamentary army, he moves with his sister, of about his own age, another somewhat younger, and a baby boy, into a sort of cell, built sometime before by a hermit, which was in connection with the cavern holding the precious charge.

The life in a cavern, within sight of Bristol, of four children, the oldest being but 14, who manage the small farm, is truly an interesting idea for lads to read of, and well indeed is it done.

After a time the elder brother comes back, full of sacred phrases on his tongue, but with much selfishness in his heart; he however is of a certain amount of use to the little family.

A child, the daughter of a sergeant who is killed, becomes an inmate of the cavern, and serves to increase the interest.

The pictures of the times are very graphic, and will do more to teach lads of what England was like then, than all the school histories we have ever seen.

The book concludes with the first Sunday when the sacred vessels are restored to the church and once more used, but we must not tell the story.

(3) Uncle Ivan. By M. Bramston.

An introduction to this tale gives us two letters, one from an elderly man in the Colonies to a sister asking for information as to an exciting episode which happened in his family when he was but a child, and the other a reply from the sister promising to do so.

The very name suggests Russia as the scene of the story, and so it is in part, as at first we find the family at St. Petersburg. After the death of the mother, who is a Russian lady, they move to England with her brother who is the uncle around whom the interest centres.

After a time, though mixed up in a plot against the Government, this uncle ventures back to Russia, where he is immediately recognised and seized; before he goes however he leaves some very important papers with his nieces, which are not to be given up to anyone who does not describe them in a particular way. Their father being away, and their governess having to leave them through ill-health, a Russian lady is engaged as their chaperone, &c. She is a Russian Government spy sent to get the papers known to be in the possession of this man, and the chief interest in the story lies in the way in which her efforts to obtain these papers are frustrated by these girls.

The two girls are very different in character, but very characteristic, and girls especially will thoroughly enjoy the tale, without perhaps gaining very much information as to the habits of Russia or England fifty years ago.

(4) **For Half-a-crown.** By Emie Stuart.

We are quite sorry to be obliged to tell so much of this original story as that the commodity which is bought and sold for half-a-crown is nothing less than a child, a young Italian girl.

An old housekeeper of a titled family is taken by her son into one of the low courts of Portsmouth, she sees a neglected dirty child, too ill to earn money, which its parents offer to sell her for three shillings; she rejects the offer with scorn, but the remembrance of the poor child haunts her, and on leaving her son the next day to return home, she cannot help visiting the court again and actually takes the child, giving half-a-crown for it.

How far it is wise to do such things can perhaps be hardly correctly gathered from this book. It is a dangerous business, interfering with other people's children whilst one even of the parents is still alive, however good the intention may be; at the same time, it will give a certain amount of pleasure, accompanied by a corresponding quantity of pain.

The difficulty in all such cases is the possible reappearance of the unnatural parent or parents, who wilfully and selfishly resigns his or her trust. The reappearance of the father in this case is the romance of the story and is sufficiently painful and sensational to delight any one loving to read of adventure.

The girl herself is interesting and repays on the whole the love bestowed on her by the good old soul that buys her.

The story is decidedly above the average, both in conception and execution, but we fancy it will interest adults almost more than young people.

(5) **A Promise Kept.** By Mary E. Palgrave.

This is hardly at all a story for young boys or girls, but might be read with great advantage by young men and women.

The hero of the story is the son of a clergyman, who has elected to leave Winchester instead of his brother, his father's means being considerably lessened through an unfortunate speculation.

Shortly after the story opens, the manor house of the village is let to some London people, and their second daughter becomes the heroine.

We do not want to tell the story, but we almost doubt whether the inconsistency of this lady is quite artistic and true.

The promise referred to in the title is to become a missionary if called upon. At first he is entirely opposed by nearly all, even those who wish all possible good for him, and the hero's willingness to be patient is very touchingly told. We may add he has his call at last, which he nobly responds to, and that his work in Africa has a wonderful effect upon the masters and boys of the school where he has been working as a master.

The tone of the book is exceedingly religious, and many of the conversations, which are somewhat long, are of the most spiritual nature.

The object of the authoress, no doubt, is to impress on young men the nobility of the missionary's calling, and the grandeur of a life lived for God.

Class Book of Physical Geography. New Edition. London: George Philip and Son.

This work, which has already passed through several editions, now appears with some corrections and with many additions. The latter have brought the work of Mr. Hughes into harmony with modern research and discovery. The comprehensive and complete statement of the distribution and arrangement of the mountain, plateau, and valley features of the globe makes the work before us of the utmost assistance to the student of Physical Geography.

The value of the work is further enhanced by the many skilfully executed and carefully selected sketch maps which sufficiently illustrate the matter and at the same time adorn the book.

The chapter on the various forms of wind movements reproduces statements which are calculated to mislead the reader. *E.g.*, p. 163, 'The portions of atmosphere which, in either hemisphere, are heated by the rays of a vertical (or nearty vertical) sun become . . . lighter than the adjacent columns of air . . . They have hence a tendency to rise into the upper strata of the entire body of the atmosphere, while the cooler and denser air of higher latitudes is set in motion *towards the place left* VACANT (?) by the ascending currents.' Again, on p. 166, we have: 'The intense heat then experienced by these lands occasions the warm and rarified air to rise, and currents of cooler air from the adjacent sea *set in to take its place*.' Similar statements appear on pp. 167, 169, and 170, in explanation of the monsoons and land and sea breezes.

This theory of air expansion, followed by 'an ascending current, while the cooler and denser air is set in motion towards the place left vacant,' p. 163, is not sustained by the quaint but expressive language of Dampier, p. 171, 'It—the sea breeze—comes in a fine, small, black, curl upon the water, where as all the sea between it and the shore not yet reached by it is as smooth and even as glass in comparison. In half-an-hour's time after it has reached the shore it fans pretty briskly,' &c.

Now according to the 'ascending current and vacant place theory' the beginning of movement should be at the spot in close proximity to the vacant place. This would be some distance inland, and gradually there would extend an indraught of air from the beach, and finally from the sea—a conclusion entirely opposed to the fact stated by Dampier.

The theory accounting for all wind movement, stated in large type on p. 163, is the sound one, and we cannot understand why it should have been disturbed by the 'vacant place' theory on subsequent pages. On page 163 winds are stated to be 'currents of air set in motion by the difference of density consequent upon various conditions of temperature.' This theory is quite sufficient to account for the chief phenomena of trade winds, monsoons, and land and sea breezes, and it further fully explains Dampier's statement, for the cold and dense air over the sea presses the lighter air over the land out of position, and thus the movement is begun over the sea and gradually extends landward.

The explanation of tidal movement does not fully nor sufficiently show why the moon exerts a greater attracting power than the sun. It is certainly not sufficient to state that the 'sun exerts a like attractive influence, but in a much less degree than the moon, owing to its vastly greater distance,' and make no reference to the condition which is essential to a complete explanation, viz., that the differential attraction of the moon upon the water nearest and furthest to it, and upon the centre of the earth, is much greater than the differential attraction of the sun upon the same positions.

Our old friend the coral *insect* (?) has entirely disappeared, thanks to the ridicule heaped upon the term by Huxley and the South Kensington examiners. What shall we say, however, to its modern substitute 'coral *worm*,' pp. 225, 226 and 228? Why not give the right term, and, if necessary, a drawing to show its chief

characteristics. We hold that without either verbal explanation or illustrative drawing, it is far better to use the term coral polype than either coral *worm* or *insect*. The strange word polype may not enlighten, at the same time it does not positively mislead, which cannot be said of the terms *worm* and *insect*.

The Examination Questions at the end of each chapter form a useful addition and will be prized by both teacher and pupil. The work is admirably printed and well illustrated.

Introduction to a Historical Geography of the British Colonies. By C. P. Lucas, B.A. Oxford: Clarendon Press.

A most valuable contribution to Colonial Geography, and especially interesting to the student of British Colonial enterprise. This is no mere collection of facts relating to the establishment of our Colonial Empire. Whilst these are stated with sufficient fulness for the geographical student they are, at the same time, skilfully arranged so as to establish and maintain historical principles of great value and authority.

As a specimen of the general arrangement of the matter we give the contents of Chapter II. on MOTIVES OF COLONISATION:—Four main motives of Colonisation: *First motive*—love of adventure, as a rule the earliest in point of time; it influences individuals more than governments or companies. *Second motive*—desire of wealth: commerce has led—(1) to system and permanence; (2) to formation of companies, and (3) to government taking part in colonisation. *Third motive*—political and social discontent. *Fourth motive*—religion, which has led (1) to exploration; (2) to conquest, and (3) to settlement; in some cases it has been a barrier between the mother country and the colony, in others it has been a link between them.

Each of the succeeding chapters—Climate and Race—Modes of Colonising and kinds of Colonists—Nations which have Colonised—Ancient, Modern, English—is worked out with a philosophical insight into the grand truths which the events of colonial enterprise are capable of teaching, and which when once grasped become principles of enlightenment and guidance in the region of commerce and politics.

British Fungi, Lichens, &c. By E. M. Holmes, F.L.S., F.R.M.S., and Peter Gray, A.B.S. London: Swan Sonnenschein and Co.

Another volume of the *Young Collector* series, and one for which we have little but praise. Fungi, mosses and lichens are so full of interest, and so very little understood, that a trustworthy guide upon the subject is most valuable and welcome. And when that guide not only describes species and mentions habitats, but also sets forth the classificatory system, and furnishes lists of the books which may be advantageously consulted by more advanced students, it is doubly useful.

This unpretending little volume consists of three distinct papers, the one, on fungi, by Mr. Holmes, and the remaining two, on lichens and mosses respectively, by Mr. Gray. The only fault that we have to find with them is that the authors are a little too much addicted to the use of scientific terms. Words such as 'angiocarpous,' 'ostiole,' 'hypothecium,' 'thalamium,' and 'paraphyses,' when occurring repeatedly, are apt to repel rather than to attract the inquirer. But there is nevertheless so much useful information in these papers that faults such as this must be condoned, and we do not hesitate to recommend the book to all whose tastes lie in the direction of the more obscure botanical families. It is in these that the most promising field for original research is to be found; and he who provides an easy pathway to this field, as has been done by the authors of this little work, has done a good deed.

Clarendon Press Series:

(1) Cicero in Q. Cæcilium Divinatio and in Verrem Actio Prima. Edited with Introduction and Notes by John R. King, M.A.

(2) The Annals of Tacitus. Book I. Edited with Introduction and Notes by H. Furneaux, M.A.

(3) Vergil. Æneid. Book I. Edited with Introduction and Notes by C. S. Jerram, M.A.

The first two of these three small volumes are portions of larger works, prepared by their respective authors for schools, and all three of them contain two parts, of which the former include the introduction and the text, and the latter the notes; and we presume these can be had separately if desired. The introductions are valuable, giving all the information a student ought to require to understand the subject-matter of the work.

In the Book of the Æneid, the text is divided into short sections, each section being headed with a statement in English, as to its contents; *e.g.*, lines 402—417 are headed thus: 'Æneas recognises his mother, who wraps him and his companions in a cloud and repairs to her Paphian shrine.' We consider this exceptionally useful and helpful.

The notes of all three volumes are explanatory as to matter, etymology and syntax, as well as critical.

The introduction to the volume of Tacitus is evidently that prepared for the larger work, as it concludes with a table of contents of the first four books of the Annals, and refers to facts and persons of whom we read in the later books.

Exercises on Mensuration for Junior Students. By T. W. K. Start. Sampson, Low and Co.

This is a not too cheap little work of 32 pages.

It contains nothing but definitions (with figures) and examples, the answers to which are printed at the end of the book.

We presume that it is not intended for self-instruction, but only as a collection of rules and examples to save the teacher time and trouble. With the single exception (as far as we noticed) of a reference to Euclid I. 47, there is not a word of explanation as to the why or the wherefore of any of the rules or numbers: *e.g.*, though, as the author proceeds to give the rule for finding the area of a circle, he states that $\pi = 3\frac{1}{7}$, or more accurately 3·1416, he does not hint as to what the number means, or why it is necessary to know it.

Again, in finding the volume of a cylinder, we are simply told to multiply the product of the square of the diameter of the base and the length of the cylinder by $\frac{11}{14}$, but where the $\frac{11}{14}$ comes from there is not a hint.

We only say this, not to find fault, but to caution students from expecting to be able to teach themselves with this work anything but the purely mechanical part of the science; and we have very great doubt whether many will work a sufficient number of examples so as to indelibly fix the unexplained non-understood rules in their memory. We also fear that the book is proportionately too dear to demand as much attention as it might, as a master's assistant.

The Instructive Geography. By Alphonzo Gardiner. London and Manchester: John Heywood.

A text book of general geography with the facts arranged under the headings first suggested by Cornwall in his widely known manual. For memory work no better arrangement can be made.

Mr Gardiner has paragraphed his matter and varied his letterpress admirably and selected his material with sound judgment.

We have contended in these pages for a more rational arrangement of geographical facts so that not only shall the memory be assisted but that the higher intellectual operations shall also be exercised.

What high educational advantage for example follows the classification of the rivers Thames, Severn, Trent, Yorkshire Ouse, Great Ouse, and Wye, on the simple basis of length? The matter which naturally groups itself round any particular river is the mountain mass in which it takes its rise, the slopes which it corrugates into valley and plain in its course; the fertility and production of the plains, with the occupation of its villages and towns, and finally the break it makes in the coast with the trade on its estuary. These form a grouping which institutes successful enquiries into the reasons of the several geographical facts enumerated.

We congratulate the author upon the series of admirable sketch maps which are liberally scattered throughout the book. That of New Zealand, p. 249, is a gem. In the diagram illustrating the Tides on p. 285 the sun is made to move round the earth whilst the moon apparently is stationary, and on page 302 the *shooting stars* which do not reach the earth are termed *meteorites (!)* The theory of the tides follows the usual mistake, viz., that the sun attracts less than the moon.

Public Examination Scripture Manuals. By Arthur Riches. Relfe Brothers.

(1.) St. Matthew's Gospel.

The information to be found in these manuals is given in the form of Question and Answer, many of the questions being those which have been actually set for the University Locals and the College of Preceptors, initials at the conclusion of each question so set showing its source. The answers are models after which the candidate is expected to train himself for examination purposes. At the conclusion of each chapter the quotations from the Old Testament as given in the New are printed side by side with the exact form found in the Old Testament, and then come a few difficult words and sentences, which are explained. At the end of the volume we find a set of questions headed 'Various,' most of which, we notice, are taken from examination papers, to which the answers struck us as particularly well done. We then have two indexes of names of individuals and of places, with lists of the miracles and parables of our Lord, concluding with a general index.

The great danger of these books compiled to assist those preparing for examination is to draw them away from the Bible itself, which is as admirable a text book for educational purposes, entirely apart from its sacred nature, as we know, and we are glad to notice that these manuals of Mr. Riches do not do so, but rather the reverse, as they constantly require reference to the Bible itself, and as such we heartily recommend them.

(2.) St. Mark.

The plan on which this work is framed is so exactly similar to its companion volume, even some answers being verbatim what we find in the other, the map of Palestine being evidently printed from the same plate, that the volume calls for no further remark.

Cassell's School Registers: Attendance Register. London: Cassell and Co. (Limited).

This register is for sixty names, has no fly-leaf, is in stiff boards, with strong cloth back. The ruling is very clear, and provides for most of the particulars required in both board and voluntary schools. One omission we notice is that of spaces for arrears of school fees received. As each double page is printed separately, there is no danger of mistakes on account of the lines not being continued across the page. A movable slip for name and address will save trouble and be of considerable service. The register can be recommended for its clearness, completeness and durability.

"Rule" Arithmetical Test Cards. London: Longmans, Green and Co.

Messrs. Longmans have again adopted a new feature in cards. They have under the above name published sets of cards in all the rules required by the five highest standards. There are thirty-two cards with one card of answers in each packet.

On the obverse side are six sums, and on the reverse either a test card or four problems. There are thus 320 examples in each packet, and as each standard has three packets, with an extra one for the fifth, there are nearly a thousand examples provided for each standard. They are issued in the publishers' well known style, and can be cordially recommended.

Second Grade Freehand Test Cards. Designed by A. Thomas, Union British Schools, South Shields. Manchester: T. Greenwell.

This is a set of sixteen designs carefully drawn, beautifully engraved, and on tinted cards. To art students wishing for good designs in freehand they will be very welcome; but the majority of the examples are much too elaborate and difficult for ordinary second grade copies.

The Popular Elocutionist and Reciter. By J. E. Carpenter. London: Frederick Warne and Co.

This is a new edition of a well known book, revised and enlarged by Leopold Wagner. It is, in our opinion, the best selection of pieces for reading and recitation yet published. The taste will be difficult to please that cannot find something suited to it in its 560 pages. There are some thirty-six pages of matter bearing upon elocution, and the greater part of the practical rules contained in them have been supplied by a master in the art. The book is cheap, and is thus within reach of everyone who has a desire to excel on the platform.

Longman's Shilling Geography. London: Longmans, Green and Co.

This marks a new departure in school books. Here is an outline of the geography of the world, with forty-five maps and nine diagrams for the coin the name of which forms part of the title. It is a well-bound book of facts and figures, illustrated on almost every other page by a map or diagram. The majority of these are remarkably clear and suitable for copying. Others, however, are too crowded, rendering the whole indistinct, and less serviceable for that purpose. The book is sure to become popular as a memory book for use in schools where oral lessons are frequent.

The Jubilee Series: Arithmetic. London: Bemrose and Sons.

These are seven books of examples only, for the seven standards. They are well printed, and issued in limp cloth. The chief features are careful graduation, numerous examples, many mental exercises, and a series of inspectors' test cards. Correctness at the examinations can only be obtained by continuous practice. This can be had with the least amount of difficulty by the use of such books as these. The answers, published in separate books, so far as we have tested them, may be relied upon as correct.

Short Narratives. For Exercises in Composition. Second Series. London and Edinburgh: W. and R. Chambers.

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Blackie's Elementary Text Books: Sonntag's French Grammar. Part II. London: Blackie and Son.

In a previous number we expressed a favourable opinion of the first part of this elementary grammar. The second part is quite equal to the first. It deals almost exclusively with the verb in its various forms, and the exercises to each lesson are well suited to test the accuracy with which the lesson has been grasped. Some ten pages of words arranged in groups, if systematically used, will give the learner an enlarged vocabulary, and at the same time serve as a capital exercise in the formation of words.

Sketch of Geological History. By Edward Hull, M.A., LL.D., F.R.S. London: C. W. Deacon and Co.

The author in this volume presents to the reader the succession of life forms found in the rocks stretching from the somewhat doubtful *Eozoon Canadense* to the epoch of man. The work has been done with a clearness and fulness which is at once the evidence and the result of very complete knowledge. As we watch the gradual unfoldings of living forms as they are revealed in the successive epochs of geological time, and then view with the author the complete representation at the present day of all these forms we come to the same conclusion as Professor Hull, when he states 'No application of the doctrine of chance can suffice to explain the origin of sucesssive forms of animal and plant life with all their beauty, harmony and adaptability to the conditions of surrounding nature. The views enunciated by Darwin and Wallace, and so successfully illustrated by living animals and plants, have only opened up to us another of those laws by which the Creator has guided and directed the development of living beings towards definite and evident ends. For, given matter, the principle of life, and the laws which govern both, what would have been the result in the absence of a governing and directing power but simply the production of living monstrosities? But even for all of these antecedents we have still to fall back on the God of nature, the Author and Giver of life, or, in the words of the great apostle, "Him in whom we live and move, and have our being."'

The County Atlas of England and Wales: and the National Atlas. Manchester: John Heywood.

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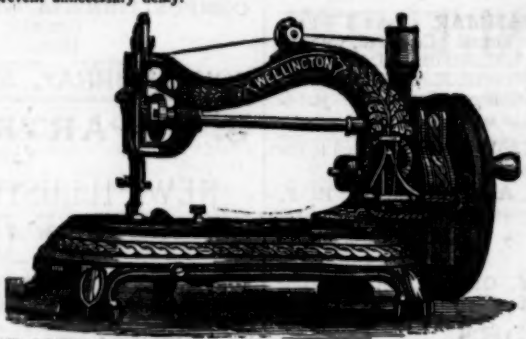

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